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CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE GEOGRAPHICAL DISTRIBUTION OF THE STUDENT BODY AT A NUMBER OF UNIVERSITIES AND COLLEGES

THE accompanying table explains the geographical distribution of the student body of thirteen American universities, six New England colleges for men, five colleges for women, two technological schools and one Pennsylvania college for men, for the academic year 1907–1908, the summer session students being in every instance omitted. *Missouri, Bowdoin, Massachusetts Institute of Technology, Purdue, Wesleyan, Bryn Maw:, Mount Holyoke, Smith, Vassar* and *Wellesley* have been added to the table. An effort has been made to group the institutions, instead of arranging them entirely in alphabetical order as heretofore.

Comparing the attendance by divisions of the six eastern universities (*Columbia, Cornell, Harvard, Pennsylvania, Princeton, Yale*) with the corresponding figures for the same universities in a similar table published in SCIENCE (N. S., Vol. XXVI., No. 656, July 26, 1907, pp. 97–104), we note in the first place that there has been a gain for these universities taken as a whole in every division, the largest increase in the actual number of students, leaving the North Atlantic division—in which all of these six universities are located—out of consideration, having been recorded in the North Central division, where there has been an increase of 117 students, this being exactly the same gain as was made last year. Foreign countries come next, as they did last year, with an increase of 92

(A) THE UNITED STATES

1907–1908	California	Columbia	Cornell	Harvard (including Radcliffe)	Illinois	Michigan	Missouri (including School of Mines)	Ohio State	Pennsylvania	Princeton	Virginia	Wisconsin	Yale	Amherst	Bowdoin	Brown	Dartmouth	Lehigh	Massachusetts Institute of Technology	Purdue	Wesleyan	Williams	Bryn Mawr	Mt. Holyoke	Smith	Vassar	Wellesley
North Atlantic Division	*5*	*3404*	*2731*	*3426*	*50*	*560*	*41*	*77*	*3343*	*885*	*51*	*68*	*2315*	*402*	*294*	*876*	*1047*	*540*	*1049*	*61*	*287*	*369*	*270*	*645*	*1089*	*657*	*871*
Connecticut	1	67	58	55	1	9	2	5	41	13	2	2	1110	19	2	27	21	5	29	2	110	21	7	99	91	51	39
Maine	.....	22	10	94	.....	7	.....	1	22	.....	.....	1	16	2	233	14	46	2	23	.....	9	5	1	25	40	9	41
Massachusetts	1	73	100	2341	5	20	8	7	76	29	3	4	174	154	40	208	534	16	781	3	37	97	25	264	397	95	348
New Hampshire	.....	11	8	79	2	5	1	2	11	3	1	2	15	2	10	40	247	1	27	.....	2	2	1	24	33	7	37
New Jersey	.....	413	190	60	2	10	1	2	298	266	10	8	117	22	.....	25	11	52	17	14	41	41	17	46	101	73	82
New York	2	2673	2025	519	23	326	23	31	168	282	20	33	640	158	5	58	99	56	82	41	60	179	59	131	302	333	160
Pennsylvania	1	122	323	165	13	163	5	28	2717	284	13	16	195	26	.....	14	7	407	57	.....	23	11	155	33	78	83	127
Rhode Island	.....	10	6	85	2	6	.....	.....	7	6	2	2	27	7	3	476	9	1	28	.....	.....	2	5	10	22	3	26
Vermont	.....	13	11	28	2	14	1	1	3	2	.....	.....	21	12	1	14	73	.....	5	1	5	11	.....	13	25	3	17
South Atlantic Division	*2*	*147*	*196*	*146*	*14*	*59*	*11*	*21*	*180*	*106*	*533*	*15*	*100*	*10*	*2*	*9*	*13*	*97*	*48*	*11*	*13*	*6*	*35*	*8*	*24*	*26*	*22*
Delaware	.....	8	11	3	.....	.....	.....	.....	48	11	5	.....	13	.....	.....	2	1	5	1	1	.....	.....	2	1	2	6	1
District of Columbia	1	15	51	42	2	26	1	1	27	21	7	4	22	6	2	.....	8	16	10	2	7	3	4	3	6	6	5
Florida	.....	5	1	5	.....	6	1	.....	8	5	12	.....	7	1	.....	.....	1	1	3	2	.....	2	1	.....	2	1	1
Georgia	.....	30	10	18	3	3	1	2	16	3	13	3	11	.....	.....	.....	.....	.....	2	1	1	.....	.....	.....	2	4	4
Maryland	.....	16	68	27	1	4	1	4	44	42	27	4	9	2	.....	3	2	54	18	2	3	.....	19	1	10	2	5
North Carolina	.....	27	12	12	1	3	.....	.....	11	5	20	.....	12	.....	.....	.....	.....	4	.....	.....	.....	1	1	1	.....	2	2
South Carolina	1	17	6	15	1	4	1	.....	5	6	13	1	3	.....	.....	.....	.....	1	2	.....	.....	.....	3	.....	1	.....	.....
Virginia	.....	21	29	16	2	5	2	4	14	10	417	.....	14	.....	.....	2	.....	11	9	.....	.....	.....	5	2	.....	4	2
West Virginia	.....	8	8	8	4	8	4	10	7	3	19	3	9	1	.....	2	1	5	3	3	2	.....	.....	.....	.....	1	1
South Central Division	*6*	*111*	*96*	*95*	*59*	*82*	*95*	*21*	*62*	*48*	*140*	*17*	*97*	*6*	.....	*7*	*5*	*9*	*37*	*84*	*1*	.....	*10*	*3*	*16*	*51*	*51*
Alabama	.....	21	12	8	2	5	3	.....	14	6	22	.....	3	1	.....	1	.....	1	4	3	.....	.....	1	1	1	4	1
Arkansas	.....	6	8	6	15	3	23	1	5	2	12	3	2	.....	.....	.....	.....	.....	2	7	.....	.....	2	.....	.....	.....	2
Kentucky	1	20	14	25	14	34	12	7	12	16	45	5	30	1	.....	4	5	3	5	46	.....	.....	.....	1	5	6	23
Louisiana	3	9	11	7	1	2	.....	1	2	1	6	.....	15	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....
Mississippi	.....	9	11	6	4	1	3	2	4	3	14	.....	5	.....	.....	1	.....	1	3	4	.....	.....	2	.....	.....	1	.....
Oklahoma	1	4	4	3	9	18	29	1	.....	.....	.....	5	5	.....	.....	.....	.....	.....	1	2	.....	.....	1	.....	.....	.....	1
Tennessee	.....	19	12	19	7	4	9	5	7	10	27	.....	14	2	.....	.....	.....	2	6	10	1	.....	1	.....	3	9	.....
Texas	1	23	24	21	7	15	16	4	18	10	14	4	23	2	.....	1	.....	2	16	12	.....	.....	2	1	7	6	4
North Central Division	*23*	*380*	*445*	*526*	*5765*	*3676*	*1999*	*2070*	*188*	*164*	*35*	*3365*	*579*	*72*	*5*	*18*	*130*	*14*	*142*	*1688*	*9*	*84*	*85*	*50*	*292*	*254*	*217*
Illinois	3	52	108	118	3329	304	44	8	23	40	3	224	148	20	1	5	70	4	31	49	.....	35	31	16	93	67	49
Indiana	3	44	34	42	109	190	7	17	19	21	3	32	30	1	.....	3	4	1	12	1438	3	3	8	3	18	17	15
Iowa	4	23	23	49	73	72	24	5	33	11	.....	86	34	4	.....	2	10	.....	16	13	.....	5	3	4	14	17	23
Kansas	1	17	13	16	27	36	28	3	11	1	1	6	14	.....	.....	1	1	.....	5	4	.....	.....	2	.....	6	3	8
Michigan	.....	33	30	31	30	2488	7	7	5	13	4	20	32	6	.....	1	5	1	8	30	.....	3	4	11	22	31	15
Minnesota	4	31	20	34	19	24	1	2	11	12	1	26	46	3	1	.....	9	2	8	8	.....	12	4	4	38	9	21
Missouri	.....	34	23	59	39	73	1853	.....	11	11	11	12	67	13	1	.....	1	1	14	9	1	3	5	1	22	13	18
Nebraska	2	11	8	6	16	23	9	.....	4	10	.....	14	12	7	.....	.....	4	.....	3	6	.....	2	7	.....	7	6	14
North Dakota	1	11	5	4	1	9	.....	1	2	3	.....	15	3	.....	.....	.....	3	1	4	.....	.....	.....	.....	.....	1	3	2
Ohio	2	88	155	138	40	378	20	2021	56	36	8	19	171	16	.....	4	21	3	26	115	4	13	14	9	52	58	47
South Dakota	.....	5	1	8	13	29	.....	.....	.....	1	1	22	7	.....	.....	.....	2	.....	3	5	.....	.....	.....	.....	1	2	3
Wisconsin	3	31	25	21	69	50	6	6	13	5	3	2889	15	2	.....	2	.....	1	12	11	1	8	7	2	18	28	9
Western Division	*2499*	*121*	*91*	*138*	*48*	*203*	*45*	*10*	*39*	*29*	*19*	*53*	*115*	*14*	*1*	*5*	*23*	*6*	*48*	*25*	.....	*9*	*11*	*2*	*48*	*29*	*49*
Arizona	3	4	.....	1	3	6	3	.....	.....	.....	.....	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....
California	2439	46	18	68	9	30	10	3	2	4	12	5	43	2	.....	3	7	.....	14	5	.....	1	4	1	11	8	13
Colorado	6	18	20	29	9	51	12	3	10	10	3	12	30	4	1	1	11	1	10	10	.....	3	2	.....	12	9	14
Idaho	4	.....	.....	1	3	11	1	.....	2	1	.....	5	2	.....	.....	.....	2	.....	.....	1	.....	.....	.....	.....	1	.....	1
Montana	1	14	7	3	3	33	2	1	.....	4	1	13	8	.....	.....	.....	.....	2	3	1	.....	.....	2	.....	2	3	2
Nevada	4	2	1	.....	.....	1	1	1	1	.....	.....	.....	1	.....	.....	.....	.....	.....	1	1	.....	.....	1	.....	.....	.....	1
New Mexico	2	1	1	5	3	5	7	1	.....	.....	.....	3	1	1	.....	.....	.....	1	1	1	.....	.....	.....	.....	.....	2	1
Oregon	26	7	19	7	3	22	2	1	3	4	1	3	7	6	.....	1	.....	.....	3	.....	.....	3	1	.....	7	.....	6
Utah	1	10	13	9	8	14	5	.....	14	4	1	.....	4	.....	.....	.....	.....	2	3	2	.....	.....	.....	1	3	.....	1
Washington	13	18	9	12	7	20	1	.....	7	2	.....	12	15	1	.....	.....	3	.....	12	4	.....	1	.....	.....	10	5	7
Wyoming	.....	1	3	3	.....	10	1	.....	.....	.....	1	.....	1	.....	.....	.....	.....	.....	1	.....	.....	1	1	.....	2	1	3
Insular & Non-Contiguous Ter.	*16*	*6*	*32*	*10*	*20*	*13*	*1*	*11*	*9*	*1*	*1*	*17*	*11*	.....	.....	.....	*3*	*6*	*12*	.....	.....	.....	*2*	.....	*1*	.....	*5*
Alaska	4	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Hawaiian Islands	9	3	4	6	.....	4	.....	.....	2	.....	.....	.....	4	.....	.....	.....	.....	.....	2	.....	.....	.....	2	.....	.....	.....	4
Philippine Islands	3	.....	18	1	20	3	1	8	2	.....	.....	17	5	.....	.....	.....	.....	.....	1	12	.....	.....	.....	.....	1	.....	.....
Porto Rico	.....	2	10	3	.....	6	.....	3	5	1	1	.....	1	.....	.....	.....	.....	3	3	.....	.....	.....	.....	.....	.....	.....	.....
Total	*2551*	*4169*	*3591*	*4541*	*3956*	*4593*	*2192*	*2210*	*3821*	*1233*	*779*	*3535*	*3217*	*504*	*300*	*915*	*1218*	*669*	*1330*	*1881*	*310*	*468*	*413*	*708*	*1470*	*997*	*1201*

students, and the South Atlantic division follows with a gain of 86 students; then comes the western division with a gain of 41, and finally the South Central division with an increase of 36 students. The total increase in divisions outside of the North Atlantic this year is much larger than last (381, against 189 in 1907 and 91 in 1906), and there has also been an increase in the gain of students from foreign countries, while last year a loss was noted (92, against 64 in 1907 and 87 in 1906). These

(B) FOREIGN COUNTRIES

1907–1908	California	Columbia	Cornell	Harvard (including Radcliffe)	Illinois	Michigan	Missouri (including School of Mines)	Ohio State	Pennsylvania	Princeton	Virginia	Wisconsin	Yale	Amherst	Bowdoin	Brown	Dartmouth	Lehigh	Massachusetts Institute of Technology	Purdue	Wesleyan	Williams	Bryn Mawr	Mt. Holyoke	Smith	Vassar	Wellesley
North America	*8*	*59*	*37*	*60*	*10*	*31*	*19*	*8*	*58*	*6*	*1*	*17*	*26*	*1*	*1*	*4*	*1*	*19*	*28*	*10*	*2*	*2*	*4*	*1*	.....	*2*	*4*
Canada	6	39	12	47	4	22	1	.....	19	2	.....	10	20	1	1	2	1	1	9	2	2	.....	4	.....	.....	1	4
Central America	.....	3	4	3	.....	.....	.....	1	16	.....	.....	.....	1	.....	.....	.....	.....	1	3	1	.....	.....	.....	.....	.....	.....	.....
Cuba	.....	12	14	4	.....	.....	.....	2	15	3	.....	1	.....	.....	.....	1	.....	9	4	2	.....	.....	.....	.....	.....	.....	.....
Mexico	2	4	7	4	5	7	18	3	6	1	1	5	4	.....	.....	.....	.....	6	12	2	.....	2	.....	1	.....	.....	.....
West Indies	.....	1	.....	2	1	2	.....	2	2	.....	.....	1	1	.....	.....	1	.....	2	.....	3	.....	.....	.....	.....	.....	1	.....
South America	*6*	*11*	*32*	*6*	*5*	*3*	*8*	*11*	*37*	*1*	*1*	*2*	*1*	.....	.....	.....	.....	*6*	*10*	*2*	.....	.....	.....	.....	.....	.....	*1*
Argentine Republic	4	1	14	5	5	.....	4	10	8	.....	.....	1	.....	.....	.....	.....	.....	1	2	1	.....	.....	.....	.....	.....	.....	.....
Brazil	.....	4	7	.....	.....	1	.....	.....	15	1	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	1
British Guiana	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Chili	1	2	1	.....	.....	1	2	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
Colombia	.....	1	.....	1	.....	1	.....	.....	8	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	1	.....	.....	.....	.....	.....	.....	.....
Ecuador	1	2	3	.....	.....	.....	.....	.....	1	.....	1	.....	.....	.....	.....	.....	.....	3	2	.....	.....	.....	.....	.....	.....	.....	.....
Paraguay	.....	.....	.....	.....	.....	.....	.....	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
Peru	.....	1	6	.....	.....	.....	2	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....
Uruguay	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
Europe	*6*	*48*	*19*	*28*	*8*	*16*	*4*	*9*	*50*	*4*	.....	*10*	*17*	*1*	*1*	*1*	.....	.....	*17*	*1*	*2*	*2*	*2*	*1*	.....	*1*	.....
Austria-Hungary	.....	2	.....	.....	1	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Belgium	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
Bulgaria	.....	.....	1	2	.....	2	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Denmark	1	2	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
France	.....	2	2	3	.....	.....	.....	.....	2	.....	.....	.....	2	1	.....	1	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....
Germany	3	9	.....	4	1	3	1	.....	5	.....	.....	5	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....
Great Britain and Ireland	1	8	5	9	1	1	1	.....	12	4	.....	3	5	.....	1	.....	.....	.....	8	.....	.....	.....	.....	.....	.....	1	.....
Greece	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Holland	.....	1	1	.....	.....	4	.....	.....	9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Iceland	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Italy	.....	2	.....	3	2	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	1	.....	.....	.....	.....	.....	.....
Norway	.....	1	1	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Portugal	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rumania	.....	1	.....	1	.....	.....	1	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Russia	1	13	2	3	.....	3	1	5	9	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	.....	.....	.....	.....	.....	.....	.....	.....
Spain	.....	1	1	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....
Sweden	.....	2	1	2	2	.....	.....	.....	4	.....	.....	1	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Switzerland	.....	1	3	.....	.....	.....	.....	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Turkey	.....	2	2	1	.....	3	.....	.....	1	.....	.....	.....	7	.....	.....	.....	.....	.....	2	.....	.....	2	1	1	.....	.....	.....
Asia	*36*	*53*	*51*	*40*	*18*	*13*	*5*	*17*	*25*	*9*	*2*	*16*	*42*	*7*	*1*	*1*	.....	*4*	*15*	*6*	*1*	*3*	.....	*1*	*1*	.....	*3*
Burmah	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ceylon	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
China	10	9	28	25	2	5	1	2	9	.....	1	4	25	.....	.....	1	.....	3	9	2	1	.....	.....	.....	.....	.....	2
Corea	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
India	14	3	11	3	5	1	2	7	2	.....	.....	.....	1	3	1	.....	.....	1	1	.....	.....	.....	.....	1	.....	.....	.....
Japan	10	37	11	8	7	6	2	3	11	7	.....	12	16	4	.....	.....	.....	.....	3	4	.....	2	.....	.....	1	.....	1
Persia	.....	3	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....
Siam	2	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Straits Settlements	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Turkey	.....	1	1	2	4	.....	.....	4	3	1	1	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....
Africa	.....	*1*	*1*	*4*	.....	.....	*1*	.....	*1*	.....	.....	.....	*2*	.....	.....	.....	.....	.....	*7*	.....	.....	.....	.....	.....	.....	.....	.....
Egypt	.....	.....	.....	1	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....
South Africa	.....	1	1	3	.....	.....	1	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	5	.....	.....	.....	.....	.....	.....	.....	.....
Australasia	*2*	*1*	*3*	*4*	.....	*1*	*2*	*1*	*45*	.....	.....	.....	*1*	.....	.....	.....	.....	.....	*3*	*1*	.....	.....	.....	.....	*1*	.....	.....
Australia	2	1	3	3	.....	.....	1	1	25	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	1	.....	.....	.....	.....	.....	.....	.....
Caroline Islands	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....
New Zealand	.....	.....	.....	1	.....	1	1	.....	20	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total (Foreign Countries)	58	173	143	142	41	64	39	46	216	20	4	45	89	9	3	6	1	29	80	20	5	7	6	3	2	3	8
Total (United States)	2551	4169	3591	4341	3956	4593	2192	2210	3821	1233	779	3535	3217	504	300	915	1218	669	1330	1881	310	468	413	708	1470	997	1201
Grand Total	*2609*	*4342*	*3734*	*4483*	*3997*	*4657*	*2231*	*2256*	*4037*	*1253*	*783*	*3580*	*3306*	*513*	*303*	*921*	*1219*	*698*	*1410*	*1901*	*315*	*475*	*419*	*711*	*1472*	*1000*	*1209*

figures contradict the statement often made that the large eastern universities are attracting fewer students from the west and south, the increase being especially noticeable in the North Central division. Calculated on a percentage basis, the total gain of the six universities in the North Atlantic division during the past year amounted to 2.30 per cent., as against a gain of 8.16 per cent. outside of the division mentioned, the figures for 1906–7 being 3.51 per cent. and 5.73 per cent., respectively. In the South Atlantic division all of these institutions show a gain with the exception of

Yale; in the South Central States the exceptions are *Harvard* and *Princeton;* in the North Central division all of them with the exception of *Princeton* show gains, these being quite substantial in the case of *Columbia* and *Cornell;* in the far western states *Pennsylvania* and *Princeton* are the only institutions that show a loss, while all of them have made gains in foreign countries.

Comparing these figures with those of three years ago (1905), we observe that the most substantial gains have been made by *Columbia* (118), *Yale* (73) and *Cornell* (64) in the North Central division: by *Columbia* (39) in the South Central division, by *Yale* (37) in the Western division, by *Pennsylvania* (33), *Harvard* (32) and *Columbia* (29) in the South Atlantic division, and by *Pennsylvania* (90), *Columbia* (56), *Harvard* (48), and *Cornell* (43) in foreign countries. It may be of interest to note in passing that at *Columbia* the number of students in attendance from the North Atlantic division on the corporation only (not including Barnard College, Teachers College and the College of Pharmacy), exclusive of the summer session, has decreased by 6.80 per cent. since 1901–2.

Taking the universities in the accompanying table by divisions, we find that *Harvard* and *Columbia* continue to have the largest representation in the North Atlantic division, *Pennsylvania, Cornell, Yale* and *Princeton* following in the order named. *Michigan's* representation has increased from 394 to 560 in three years, while the other western universities—*California, Illinois, Missouri, Ohio State* and *Wisconsin*—and the *University of Virginia,* attracted comparatively few students from this section of the country, *Ohio State* heading the latter list with 77 students, as against 64 last year. Every one of these western institutions, however, with the exception of *California,* shows gains in attendance in this division over last year. *Harvard,* as usual, leads in all of the New England States, with the natural exception of Connecticut, where *Yale* has the largest following. *Columbia* and *Cornell,* as we should expect, have the largest representation in New York State, *Yale, Harvard, Michigan* and *Princeton* following in the order named, *Michigan,* which has registered an increase in this state from 195 to 326 in three years, having passed *Princeton* since last year. In New Jersey the order is *Columbia, Pennsylvania, Princeton, Cornell, Yale* and *Harvard—Pennsylvania* having passed *Princeton* in this state since last year. The *University of Pennsylvania* naturally leads in its own state, followed by *Cornell, Princeton, Yale, Harvard* and *Columbia—Princeton* having been passed by *Cornell* since last year.

Examining the attendance of the men's colleges and technological schools from these states, we note that the order for the entire division is *M. I. T., Dartmouth, Brown, Lehigh, Amherst, Williams, Bowdoin, Wesleyan—Purdue* naturally bringing up the rear. Of course *Bowdoin* leads in Maine and *M. I. T.* in Massachusetts, with *Dartmouth* second in both instances, while the latter institution, as would be expected, has the largest number of students from New Hampshire and Vermont. *Brown* and *Harvard* are the only institutions that attract students from Rhode Island in any considerable number. In Connecticut *Wesleyan* naturally leads, followed by *M. I. T., Brown, Dartmouth* and *Williams,* and *Amherst,* all of the eastern universities, except *Princeton,* having a larger representation in this state than any of the New England colleges for men outside of *Wesleyan* included in the table. Compared with 1906, all of the colleges included in both tables (*Amherst, Dartmouth, Lehigh* and *Williams*) show an increase in their representation from the

North Atlantic states, while compared with last year *Williams* shows a loss, as does *Brown*.

In New York State the order for the colleges is *Williams, Amherst, Dartmouth, M. I. T., Wesleyan, Brown* and *Lehigh*. Of the four New England colleges included in both this and last year's tables, 30 per cent. of the students of *Amherst* as against 36 per cent. last year and 43 per cent. in 1906, have their permanent home in Massachusetts; 52 per cent. of *Brown's* student body, as against 53 per cent. in 1907, come from Rhode Island; 20 per cent. of *Dartmouth's* students, as against 21 per cent. last year and 24 per cent. in 1906 come from New Hampshire (26 per cent. as against 27 per cent. and 32 per cent., respectively, from New Hampshire and Vermont), and 20 per cent., as against 20 per cent. last year and 21 per cent. in 1906, of the student enrollment of *Williams* hail from Massachusetts. *Lehigh's* percentage of students from the state of Pennsylvania remains uniform at 58 per cent., as against 60 per cent. in 1906, while *Bowdoin* draws 77 per cent. of its student body from Maine, *M. I. T.* 55 per cent. from Massachusetts, and *Wesleyan* 35 per cent. from Connecticut. It is thus seen that of these institutions *Williams* and *Dartmouth* attract the largest percentage of students from outside their own state, followed by *Amherst, Wesleyan, Brown, M. I. T., Lehigh, Purdue* and *Bowdoin*. *Dartmouth* attracts more students from Massachusetts than from all of the other states in the North Atlantic division combined. *Amherst* and *Williams* draw more from New York than from Massachusetts, while *Princeton* draws more from New York and from Pennsylvania than from New Jersey.

Of the eastern universities, *Pennsylvania* continues to have the largest percentage of enrollment from its own state, namely 67 per cent., the same percentage as in 1906; of *Columbia's* student body 62 per cent. come from New York State, as against 66 per cent. in 1906; *Cornell's* percentage of New York students has dropped from 56 per cent. in 1906, to 54 per cent.; of *Harvard's* students 52 per cent., as against 54 per cent. in 1906, are residents of Massachusetts; of *Yale's* students 34 per cent., as against 33 per cent. in 1906, have their permanent residence in Connecticut, and, finally, of *Princeton's* students only 21 per cent., as against 20 per cent. in 1906, are residents of the state of New Jersey. The institutions in this group which exhibit a gain in the percentage of students from outside their own state during the past year are *Columbia, Cornell* and *Pennsylvania* (2 per cent. each) and *Harvard* (1 per cent.), *Princeton* and *Yale* having remained uniform.

Coming to the South Atlantic division and taking into consideration only the six eastern universities, we note that the order is exactly the same as it was two years ago, namely, *Cornell, Pennsylvania, Columbia, Harvard, Princeton, Yale*. The *University of Virginia* naturally has the largest following in this section; *Michigan* continues to be the only one of the western universities represented in the table to make a fair showing in these states, while *Lehigh* is the only one of the colleges with a good representation from this division, its main strength lying in the state of Maryland. So far as the individual states are concerned, *Pennsylvania* naturally leads in Delaware, *Cornell* in the District of Columbia, *Virginia* in Florida, *Columbia* in Georgia, North Carolina, and South Carolina, *Cornell* in Maryland, and *Virginia* in its own state (with *Cornell* second) and in West Virginia. The only change to be noted here since last year is the lead of *Cornell* instead of *Lehigh* in Maryland. Leaving the state of Virginia out of consideration, *Columbia, Cornell, Harvard*

and *Pennsylvania* have a larger clientele in the South Atlantic division than *Virginia.*

In the South Central division *Virginia* heads the list, followed by *Columbia* (111, as against 72 in 1905), *Yale* (97–80), *Cornell* (96–76), *Harvard* (95–80), *Michigan* (82–64), *Pennsylvania* (62–44), *Illinois* (59–47) and *Princeton* (48–72). *Purdue* attracts 84 students from this division, and *M. I. T.* 37. The New England colleges for men, and *Lehigh* and *California* have only a small following from this section (*Bowdoin* and *Williams* have not a single student from this division), while the girls' colleges make a far better showing, both *Vassar* and *Wellesley* drawing no less than 31 students each from the South Central States. *Columbia* has made the largest gain in this division, while *Princeton's* clientele shows a falling off. The largest representation from the individual states is found at the following universities: Alabama—*Virginia, Columbia, Pennsylvania;* Arkansas—*Missouri, Illinois, Virginia;* Kentucky—*Purdue, Virginia, Michigan;* Louisiana—*Yale, Cornell, Columbia;* Mississippi—*Virginia, Cornell, Columbia;* Oklahoma—*Missouri, Michigan, Illinois;* Tennessee—*Virginia, Columbia* and *Harvard,* and Texas—*Cornell, Columbia* and *Yale.* Kentucky continues to send by far the largest delegations to the institutions contained in the list, followed by Texas, Tennessee and Alabama.

In the North Central division the five universities and the technological school of that section, *Illinois, Michigan, Wisconsin, Ohio State, Missouri* and *Purdue,* in the order named, naturally have the largest clientele. Of these six institutions, *Michigan* draws the largest percentage of students from outside of its own state, 53 per cent. of its enrollment hailing from Michigan, the corresponding figure for *Purdue* being 76 per cent., for *Wisconsin* 81 per cent., for *Missouri* 83 per cent., and for *Ohio State* 91 per cent. The clientele of the five middle western institutions last mentioned is, therefore, much more local in character than that of any of the eastern institutions comprised in the table, whereas *Michigan* attracts a larger percentage of students from outside of its own state than do *Pennsylvania, Columbia, Cornell, Lehigh,* or *M. I. T.* Of the eastern universities *Yale* still has the largest clientele in this section of the country, followed by *Harvard, Cornell, Columbia, Pennsylvania* and *Princeton,* the last named institution having been passed by *Pennsylvania* since last year. The largest gains in individual states (15 or more) during the past three years have been made by *Columbia* in Illinois, Ohio and Wisconsin, by *Cornell* in Ohio, by *Harvard* in Missouri, by *Pennsylvania* in Iowa, and by *Yale* in Missouri and Ohio. *Columbia's* representation in this group of states has grown from 262 to 380 in three years, *Cornell's* from 381 to 445, *Pennsylvania's* from 139 to 188, and *Yale's* from 506 to 579, while *Harvard's* has remained stationary at 526, and *Princeton's* has dropped from 209 to 164. Of the New England colleges for men, including *M. I. T.,* the last named institution has the largest following in the North Central division (142), with *Dartmouth* second (130), *Williams* third (84) and *Amherst* fourth (72), *Smith, Vassar* and *Wellesley* all drawing a much larger body of students from this section than the men's colleges, in fact, all three of these girls' colleges have a larger clientele from this division than either *Pennsylvania* or *Princeton.* The representation of *Amherst* in these states has grown from 43 to 72 in two years, that of *Dartmouth* from 91 to 130, while *Williams* shows a loss of two students. *Virginia* and *California* have only a small following in this division. Leaving the state institution out of consideration in

each case, *Michigan* is seen to have the largest following in Illinois, followed by *Wisconsin, Yale, Harvard* and *Cornell*, each of which has over one hundred students from this state. *Michigan* also leads in Indiana, followed by *Illinois, Columbia, Harvard, Cornell.* In Iowa the order is *Wisconsin, Illinois, Michigan, Harvard, Yale;* in Kansas—*Michigan, Missouri, Illinois, Columbia, Harvard;* in Michigan—*Columbia, Yale, Harvard* and *Vassar, Cornell* and *Illinois* and *Purdue;* in Minnesota—*Yale, Smith, Harvard, Columbia, Wisconsin, Michigan;* in Missouri—*Michigan, Yale, Harvard, Illinois, Columbia;* in Nebraska—*Michigan, Illinois, Wisconsin* and *Wellesley, Yale, Columbia;* in North Dakota—*Wisconsin, Columbia, Michigan;* in Ohio—*Michigan, Yale, Cornell, Harvard, Purdue, Columbia;* in South Dakota —*Michigan, Wisconsin, Illinois;* and in Wisconsin—*Illinois, Michigan, Columbia, Vassar, Cornell, Harvard.* Excluding in each case the respective state university, the state of Illinois is represented by 1,537 students at the institutions mentioned in the list, Ohio by 1,493, Michigan by 351, and Wisconsin by 348, that is, 58 per cent. of the state of Ohio's representatives at all of the institutions included in the table are enrolled at the state university, while the percentage for Illinois is 68 per cent., for Michigan 88 per cent., and for Wisconsin 89 per cent.

In the western division (leaving *California* out of consideration) *Michigan* continues in the lead, with *Harvard, Columbia* and *Yale,* each of which attracts over one hundred students from this section, following; then come *Cornell, Wisconsin, Wellesley, Illinois* and *M. I. T.* and *Smith, Missouri, Pennsylvania, Princeton* and *Vassar, Purdue, Dartmouth,* the remaining institutions drawing only a few students from the far western states. *Michigan's* representation has grown from 134 to 203 in three years; *Harvard's* from 126 to 138; *Columbia's* from 111 to 121; *Yale's* from 78 to 115; *Cornell's* from 76 to 91; *Illinois'* from 41 to 48; *Pennsylvania's* from 22 to 39, while *Princeton's* has dropped from 41 to 29. *Michigan* leads in Arizona, Idaho and Wyoming; in California (leaving the state university out of consideration) *Harvard* continues to lead, with *Columbia, Yale* and *Michigan* following; in Colorado the order is *Michigan, Yale, Harvard, Cornell;* in Montana—*Michigan, Columbia, Wisconsin; California* leads in Nevada, the state which has the smallest total representation of any of the states; *Missouri* leads in New Mexico; in Oregon the order is *California, Michigan, Cornell;* in Utah—*Michigan* and *Pennsylvania, Cornell, Columbia,* and in Washington—*Michigan, Columbia, Yale.* Of the states in the western division Colorado and California continue to send by far the largest delegations to the eastern institutions in the list.

Cornell continues to lead in the number of students from the insular possessions, followed by *Illinois.* There were last year only seven representatives from Alaska at the institutions mentioned in the table. *California* leads in Hawaii, *Illinois* in the Philippines, and *Cornell* in Porto Rico. Taking only the institutions included in the tables both this year and last year, there has been an increase of one student from Hawaii, of fourteen from the Philippines and of five from Porto Rico.

Taking only the six eastern universities, the table shows that *Columbia* leads or is tied for first place in seventeen states and territories, *Yale* in fourteen, *Harvard* in twelve, *Cornell* in ten, *Pennsylvania* in four, and *Princeton* in none, as follows: *Columbia*—New Jersey, New York, Georgia, North Carolina, South Carolina, Alabama, Tennessee, Indiana, Kansas, Michigan, North Dakota, Wisconsin, Arizona, Montana, Nevada, Washington and

Alaska; *Yale*—Connecticut, Florida, West Virginia, Kentucky, Louisiana, Oklahoma, Illinois, Minnesota, Missouri, Nebraska, Ohio, Colorado, Idaho and Alaska; *Harvard*—Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, Tennessee, Iowa, South Dakota, California, New Mexico, Wyoming and Hawaii; *Cornell*—District of Columbia, Maryland, Virginia, Arkansas, Mississippi, Texas, Oregon, Wyoming, Philippine Islands and Porto Rico; *Pennsylvania*—Pennsylvania, Delaware, Idaho and Utah.

The total number of students from foreign countries in attendance at the institutions represented in the accompanying table as well as in that of last year has grown from 946 to 1088, an increase of no less than 15 per cent., to which the various continents contributed as follows: North America's representation has grown from 314 to 348; South America's from 103 to 122; Europe's from 200 to 219; Asia's from 272 to 332, and Australasia's from 45 to 58, while Africa's has dropped from 12 to 9. Asia exhibits the largest increase, as it did last year.

Pennsylvania continues to have the largest foreign clientele, followed by *Columbia, Cornell* and *Harvard,* each of which attracts over one hundred foreigners. Of the western institutions *Michigan* is still in the lead, followed by *California, Ohio State, Wisconsin, Illinois* and *Missouri. Virginia,* the New England colleges for men, and the colleges for women attract only a few students resident in foreign countries, while *M. I. T., Lehigh* and *Purdue,* especially the first, all have a fair representation.

Examining the foreign delegations of the different institutions by continents, we note that the order in North America is *Harvard, Columbia, Pennsylvania, Cornell, Michigan, M. I. T., Yale;* in South America—*Pennsylvania, Cornell, Columbia* and *Ohio, M. I. T.;* in Europe—*Pennsylvania, Columbia, Harvard, Cornell, M. I. T.* and *Yale, Michigan;* in Asia—*Columbia, Cornell, Yale, Harvard, California, Pennsylvania;* in Africa *M. I. T.* leads, while in Australasia *Pennsylvania* continues to be the only institution with a good representation. Of the countries that send at least eight students to any one institution *Harvard* leads in Canada; *Pennsylvania* in Central America, Cuba, Brazil, Colombia, Great Britain and Ireland, Holland, Australia and New Zealand; *Missouri* in Mexico; *Cornell* in the Argentine Republic and China; *Columbia* in Germany, Russia and Japan; *California* in India.

Taking the representation of foreigners at all of the institutions mentioned in the list, we find that the largest delegations are sent by the following countries: Canada, 210; Japan, 142; China, 139; Mexico, 90; Cuba, 67; Great Britain and Ireland, 60; Argentine Republic, 56; and India 54. As for individual countries in America, the order for Canada is *Harvard, Columbia, Michigan, Yale, Pennsylvania; Pennsylvania* continues to have the best Central American representation, and also leads in Cuba, with *Cornell* second and *Columbia* third; *Missouri* leads in Mexico, with *M. I. T.* second, and *Purdue* in the West Indies, although the representation from these islands is very small. Of the South American countries the Argentine Republic sends the largest delegation, followed by Brazil.

In the European countries that send eight or more students to any one institution the order is as follows: Germany—*Columbia, Pennsylvania* and *Wisconsin;* Great Britain and Ireland—*Pennsylvania, Harvard, Columbia;* Holland—*Pennsylvania, Michigan;* Russia—*Columbia, Pennsylvania, Ohio State.* England sends the largest number, namely 60, followed by Russia with 40 and Germany with 32. Of

the Asiatic countries, counting only the institutions represented in last year's table, Japan sends 131, China 124 and India 49, as against 116, 84 and 39, respectively, last year. *Cornell* draws the largest number of students from China, followed by *Harvard* and *Yale; Columbia* draws more than twice as many students from Japan as the second institution, *Yale*, while *California*, as we have seen, leads in India.

The figures given in the table are intended to represent *not* the birthplace of the students, but their permanent residence, although the absolute accuracy of the table is somewhat impaired by the fact that students occasionally give as their permanent residence the state where the institution at which they are enrolled is located, this being especially true of the state universities, where students take up a temporary residence in the state to escape tuition fees.

RUDOLF TOMBO, JR.
COLUMBIA UNIVERSITY

THE DUBLIN MEETING OF THE BRITISH ASSOCIATION, SEPTEMBER 2–9, 1908

THE meeting proved to be one of the best attended and most successful ever held by the British Association for the Advancement of Science. A total of 2,270 tickets were issued, of which 1,152 belonged to the class of associate members.

The first day, Wednesday, was devoted to registration, the president's address being delivered in the evening in the graduation hall of the university. Owing to the terrific storm that had been raging on the British coasts the previous three days, most members put off crossing the Irish channel as late as possible, but even Wednesday afternoon's crossing was slightly rough. Work in the various sections started on Thursday, September 3. Nearly all the sections were housed in the grounds of Trinity College, and an inter-sectional automobile service, arranged through the generosity of local members, provided swift means for reaching outlying meeting places. The usual post-office information bureau, news stand, excursion counter, and lounge were located in the examination hall, and the daily journal gave prompt information as to the doings of the sections. A welcome and most efficient innovation were the "indicator boards," announcing what papers were being read in each section. The boards contained the letters A to L, representing the various sections, and underneath each letter was hung a card bearing the number of the paper under discussion at the moment. The "indicator boards" were kept up to date by four special operators for each section, telephonic communication proving very helpful. The number of abstracts of the papers read supplied to members proved for once adequate to the demand.

Thursday was ushered in by heavy rains, which marred the success of the Provost's garden party in the afternoon, held in the Fellows' garden. The party was well attended, however, and afforded the usual enjoyable opportunity for meeting old friends whilst listening to the music of the band and taking tea in the marquees.

Guiness's brewery was visited by parties of members on several days, and other works in the vicinity were also thrown open for inspection. A very interesting series of Irish plays was being given at the Abbey theater, and the many who went there enjoyed the novel, excellent and characteristic acting in the native plays. A record crowd attended the conversazione given by the Royal Dublin Society in the evening at Leinster House. Most of the members (about 3,000) of the society attended with friends, and their number was swelled by about 1,500 British Association members. The large house, together with the beautiful rooms in which are placed the collections

of the Dublin Museum, accommodated the visitors easily—when once they had passed the all too narrow entrance, from which extended long lines of carriages, some of which had been waiting for two hours to discharge their occupants. The scene in the galleries and down the various flights of steps in the museum was as pretty a one as the writer had ever seen. The guests were received by Lord Ardilaun, president of the society (part owner of Guiness's), the Right Hon. Frederick Trench and Sir Howard Grubb. The Lord Lieutenant of Ireland, accompanied by some of his household, arrived later in the evening.

Friday was occupied with sectional meetings, and the conferring of honorary degrees in the afternoon on Mr. Francis Darwin, F.R.S.; Sir David Gill, K.C.B., F.R.S.; Dr. William Napier Shaw, F.R.S.; Captain Henry George Lyons, F.R.S.; Professor Horace Lamb, F.R.S.; Professor Charles Scott Sherrington, F.R.S.; Professor Ernest Rutherford, F.R.S.; Professor Archibald Byron Macallum, F.R.S.; Dr. Albert Kossel; Dr. Ambrose Arnold William Hubrecht; Sir Thomas Lauder Brunton, Bart., F.R.S., and Sir James Augustus Henry Murray. In the afternoon the general committee met and decided to hold the 1910 and 1911 meetings at Sheffield and Portsmouth, respectively. Professor J. J. Thomson was elected as President for 1909.

Friday afternoon was devoted to garden parties at Dunsink Observatory and Saint Patrick's Cathedral. The Dunsink party was limited to 200, and over 700 applications had been received for tickets. A most enjoyable drive through Phœnix Park and past the Vice-regal Lodge brought the members to the observatory grounds. An old transit circle, last used in 1860, excited particular interest. In the evening a crowded audience listened to a lecture by Professor H. H. Turner, F.R.S., on Halley's comet.

Over 1,000 persons took part in Saturday's excursion, which included the Boyne Valley, Bray, Powers Court, and Kilruddery, Glendalough, the Rock of Cashel and the Shannon Valley. The Boyne Valley excursion provided a seven hours' drive in jaunting cars and included the inspection of the old tumuli at Louth and the ruins of Mellifont Abbey.

Garden parties were given on Monday, Tuesday and Wednesday by Lord Ardilaun, at the Zoological Gardens, and at the Vice-regal Lodge, but the enforced departure of the writer early Sunday morning on the *Lusitania* from Queenstown prevented his attending them.

Professor W. M. Davis, of Harvard, gave a lecture on Monday on "The Lessons of the Colorado Cañon."

All the sectional meetings were well attended. There were present from this side of the water: Professor W. M. Davis, of Harvard University, vice-president of the geological and geographical sections; Professor A. L. Rotch, Blue Hill Observatory, Mass., on committee of mathematical and physical section; Dr. Leo F. Guttman, College City of New York, on committee of chemical section; Drs. W. E. Praeger, Kalamazoo College, Mich.; Carroll Dunham, Harvard; Elizabeth H. Dunn, Chicago University; President E. J. James, Illinois; Dr. W. H. Hale, Brooklyn; N. M. Fenneman, Cincinnati, and Miss M. E. O'Brien, Boston, Mass.

Subjoined is a report of interesting papers read before some of the sections, together with an account of the discussions thereon. Notes had been taken, and an attempt has been made to faithfully reproduce the statements of the speakers, but strict accuracy is not claimed for the remarks quoted.

Abstract of Address to the Chemical Section: Professor F. S. Kipping, D.Sc., Ph.D., F.R.S.

During the past few months we have read in the daily journals—and we sincerely hope it may be true—that there are signs of the commencement of a great development of the resources of this island; as such a desirable event must be closely connected with, and, indeed, may even be dependent on, the vitality of the chemical industries of the country, the moment seems opportune for the consideration of a subject which has a direct bearing on both commerce and chemistry.

Although this section is chiefly occupied with matters relating to pure science, the discussion of industrial questions is also regarded as one of its important functions; it does not attempt to distinguish pure from applied chemistry, and any problem which concerns either is deemed worthy of its attention.

From this point of view I propose to consider whether any steps can be taken to place the chemical industries of the United Kingdom of Great Britain and Ireland in a more prominent position than that which they now occupy in the world of commerce.

The subject is not new; it has been dealt with by many, but principally by those more directly interested—prominent members of the Society of Chemical Industry, who are far better qualified to express opinions on commercial matters than am I. It is perhaps presumption on my part to attempt to add anything to what has been said by such leaders of industrial chemistry, but I propose to deal with the subject from a very different standpoint—namely, from that of the teacher in the class-room and laboratory. Even if I fail to make a single suggestion of immediate practical value, the question is one of such magnitude and so many-sided that I feel justified in bringing it under the notice of this section. It is not merely a matter of money, of a few millions or of a few tens of millions sterling. There are few branches of industry to which chemistry, in one way or another, is not of supreme importance. Whether we look to the great shipbuilding interests, dependent on the progress of metallurgy; to our cotton and linen trades, where cellulose reigns supreme; to our dye-houses or to our breweries, or to any other industry, great or small, there do we find problems in chemistry awaiting solution, and the nation which solves them will not only progress in civilization and contentment, but will also justly claim to have taken a leading part in the advancement of science.

It is unnecessary to trouble you with any detailed comparison of the position which we occupy to-day with that which we have taken in the past. The fiftieth anniversary of the epoch-making discovery of mauve was held only two years ago, and the proceedings are still fresh in our recollection; the pæans of congratulation addressed to the discoverer (now, alas! no longer with us) were marred by a plaintive note, a note of lamentation over our lost industry, the manufacture of dyes. The jubilee of the founder of the color industry in this country was also the occasion for pronouncing its funeral oration. If this were the full extent of our loss we might bear it with equanimity; but it is not so much what has already gone as what is going and what may go that are matters of such deep concern. Those who doubt the seriousness of our condition may find statistical evidence, more than sufficient to convince them, in the technical journals and in the board of trade reports of recent years.

The new Patent Act which came into force this year, and for which the country is so much indebted to the strenuous advocacy of Mr. Levinstein and Sir Joseph Lawrence, seems to many to have inaugurated a new era, and to have removed one of the principal causes of the decline of our chemical industries; if this be so, it is all the more important that the representa-

tives of chemical science should be ready and willing to join hands with the manufacturers in order to assist in the process of regeneration.

The principal changes which have been introduced by the new law are, of course, familiar to all. The most important one, which came into operation on August 28 last, is that which requires that the article or process which is protected by the patent must be manufactured or carried on to an adequate extent in the United Kingdom after the expiration of four years from the date of the patent. If this condition is not fulfilled, any person may apply for the revocation of the patent.

Some of the results of this amendment, and some indications of the great industrial changes which it will bring about, are already obvious. Foreign firms or individuals who hold British patents and who have not sufficient capital to work them in this country, or who do not think they are worth working here, are attempting to sell their British patent rights. Others are building or buying works in Great Britain, and it has been estimated that in the immediate future a sum of at least 25,000,000*l.* of foreign capital will have been thus invested in order to comply with the new law.

We need not stop to consider the economic effects of this transfer of capital on the general trade of this country, but we may well pause a moment in order to try and forecast the consequences of these new conditions in so far as they concern our chemical industries.

The prospective establishment of branches of two of the largest German chemical works at Ellesmere Port and at Port Sunlight, respectively, is already a matter of common knowledge, and it may be presumed that these firms will avail themselves to a large extent of British labor. If this be the case, and if they are successful—as they, no doubt, will be—the complaint that the inferior technical education of our artisans is responsible for our lack of success will thereby be proved to be groundless. Even if we admit that at the present time the British workman is an inferior operative in a chemical works, and only capable of undertaking the less-skilled labor, these firms will gradually raise a considerable number of trained men who will be ready to undertake more responsible duties under our own manufacturers when the good time comes; a school for chemical operatives will be created in our midst, and, as in the past, we shall reap the benefit of knowledge and experience brought to our shores. It also seems reasonable to expect that, as is the case abroad, these works will be equipped with laboratories and staffed by chemists, although possibly only so far as is necessary for routine work. Many of these chemists may settle permanently in our midst, become members of our Chemical Society and Society of Chemical Industry, and thus infuse us with their patience and perseverance. It is not beyond the bounds of possibility that these great firms may even employ British chemists in their works, if we can supply men sufficiently well trained to be of value. On the other hand, as experience seems to have shown that industrial chemistry can not succeed with imported scientific labor, it is not very probable that many posts in the laboratory will be filled by our countrymen, who, in this connection, must be regarded as foreigners.

Now at the present time most chemical products can be manufactured more cheaply abroad than here, otherwise we should not have any reason to consider our position. Even if, owing to inefficient labor, higher wages, freight and other economic conditions, production is more costly here, the superior efficiency and sci-

entific organization of these foreign firms will nevertheless enable them to command our home market with the goods made here.

The conclusion which thus seems forced upon us is that, although the new Patent Act will prove to be of great value in many respects, it will do little to foster British chemical trade and the developments of British chemistry; it places us on an equality with other countries as regards patent rights, and thus remedies an outstanding grievance; but unless we have something to patent, this equality will be valueless and our chemical industries will continue to decline, possibly more rapidly than heretofore.

Among the other causes which have been suggested as contributory to our failure are: (1) The unsatisfactory condition of secondary education; (2) the nature of the training which is given to chemists in our universities and other institutions; (3) the insufficiency of the time and money devoted to research in the manufacturing industries; (4) the lack of cooperation between manufacturers and men of science. There are some of us who believe that the first of these is the primary. . . .

In a presidential address to the Chemical Society last year Professor Meldola discussed the position and prospects of chemical research in Great Britain, and in view of the importance of the subject and the able manner in which it had been treated, the Council of the Society ordered the publication of five thousand copies of his address for distribution among the members of various public bodies. We were told in this address that many of our universities are distinct failures as centers of chemical research, and that the output of original work from our colleges, polytechnics and similar institutions is emphatically not representative of the productive power of the teachers there employed. The causes of the failure of our universities were only lightly touched upon, and I propose to refer to them later; but in the case of our other institutions they were more fully discussed. May I venture to draw attention to one cause, which I believe is by far the most effective drag on research in the vast majority of such institutions not of university rank? It is simply the lack of those more advanced students who, while gaining valuable experience in the methods of research, would also render useful assistance to their teacher. The governing body of the institution may not realize the importance of research; the principal, as, alas! is sometimes the case, may throw cold water on such work; the teacher may be overburdened with routine duties, and he may be most inadequately remunerated; if, however, the research spirit is strong within him, he would overcome all these difficulties were there any prospect whatsoever of success; but what chance has he when he must do everything himself, even to washing out his own test-tubes? Provide him with a few advanced students, and he would doubtless find time to undertake the necessary pioneer research work, which would then be extended and developed with their assistance.

It might be suggested that an efficient and enthusiastic man would soon attract a number of research students. This, no doubt, is true as regards the universities, but it must be remembered that a polytechnic or other institution which does not grant degrees can hardly expect to compete with a university as a center for research; all those students who intend to undergo a so-called "complete" course of study—that is to say, all who are likely to become capable of undertaking research work—naturally proceed to one of the degree-giving universities. There are not enough students to go round, to satisfy the research requirements of the teachers, and

the principal reason is—the limited demand for trained chemists on the part of the manufacturers.

Even of the small number of those who leave our teaching institutions fairly well trained in research, how many have a chance of passing into works and directly advancing applied science? A very small proportion indeed. Most of the better ones drift into other posts, become demonstrators, emigrate—anything rather than wait on with the prospect of accepting as works-chemist a salary which, meager though it be, may be stopped altogether if dividends are low.

With whom rests the responsibility for this state of affairs? Is it with the teachers, and, if so, is it because they are incapable of training chemists or because their system is at fault?

To answer this question it is necessary in the first place to arrive at some conclusions as to the kind of training which is required for the future works-chemist. On consulting the opinions of the manufacturers it would seem that they attach great importance to what is called the "practical side"; they believe that, in addition to a knowledge of theoretical chemistry, the prospective works-chemist should also have some acquaintance with engineering, should understand the apparatus and machinery used in the particular manufacturing operations with which he is going to deal, and should have had practical experience in working the given process. It is from this point of view that we build and equip large technological chemistry departments, such as those in the Universities of Birmingham and Leeds and in the Manchester Municipal School of Technology, departments fitted up with complete apparatus and machinery for carrying out operations on a miniature manufacturing scale.

The arguments in favor of this view, that it is a hybrid chemist-engineer who is required in a chemical works, seem to me to be fundamentally unsound, and the kind of training suggested by them for the works-chemist can only result in the production of a sort of combined analytical machine and foreman. A two or three years' course of science, followed by one year's practical work in the dye-house, in paper-making, or in some other technological department, is quite inadequate if the student trained in this way is expected to do anything beyond routine analytical work and supervision. We can not possibly expect such a poorly trained jack-of-all-trades to run a chemical works successfully in the face of competition directed by a large staff of scientific experts in chemistry and in engineering. The conditions in a chemical works can not be successfully imitated in a university or polytechnic; attempts to do so can only lead to mistaken conclusions, and thus have the effect of rendering the works-chemist quite helpless when he passes from the elegant models of his educational apparatus to the workaday appliances of the manufactory.

Here, it seems to me, we touch the bedrock of our trouble. The state of our chemical industries must be attributed to the erroneous views which have been and still are held as to the functions, and consequently as to the training, of a works-chemist. We have failed to realize that industrial chemistry must be based on a foundation of continuous and arduous research work. In the past we have sent out from our universities and other institutions students who no doubt were qualified to undertake routine analytical work, but the great majority of whom knew nothing of the methods of research. We are doing the same to-day. Just when a student has reached a stage at which his specialized scientific training should begin his course

is finished, and whether he has been to a university or to a polytechnic matters little; he joins the band of those who subsist on but who do nothing to advance chemical industry. He enters a works; the manufacturer does not realize exactly what his chemist ought to do, but he expects some immediate results, and in consequence is generally disappointed; the lack of success of the chemist is put down to his ignorance of practical matters, and there is an outcry for technical education; science is most unjustly discredited, and any suggestion of spending money on research work is scouted as a mere waste.

The consequence is that if there is a scientific problem which intimately concerns all the members of some large industry, what course do they adopt? Through their trade journal, and as an association representing a total capital of which I should not like to hazard a guess, they offer a bronze or possibly a silver medal, or may even offer the extravagant sum of 20*l.*, to the happy person who will provide them with a solution. It is difficult to imagine the class of solvers to whom these princely rewards may appeal, more difficult still to believe that any useful result can be attained, and it is almost incredible that such methods should be adopted by any influential industrial organization. This way of attempting to get research work "on the cheap" is certainly not unknown even in more enlightened countries, but that is hardly a sufficient justification for its employment.

Contrast these methods with those adopted by the Badische Anilin- und Soda-Fabrik and Meister, Lucius & Brünig in their attempts to solve the problem of the commercial synthesis of indigo. Could there be a greater antithesis? If five thousand copies of Brunck's Paper on this subject[1] could be circulated among the manufacturers of this country—a task which might be fittingly undertaken by the Society of Chemical Industry—the study of the truly magnificent results attained by the systematic application of pure science, and of the indisputable evidence of their commercial value, might prove an object-lesson far more effective than argument for the accomplishment of a sorely needed reform.

Now if we are to meet successfully the very formidable scientific and commercial organization opposed to us in chemical industry, we must perforce adopt the methods of our competitors; not only must we learn patience and perseverance, but we must also call to our aid the best brain-power available. We must recognize clearly that the scientific-works chemist, the only man who is likely to make discoveries of commercial value, must be thoroughly trained in the methods of research by those best qualified to do so, and we must not imagine that when he enters the works he should or could immediately become an engineer and a commercial expert; his place is in the research laboratory. The practical man—that is to say, the man who has a thorough and useful knowledge of some particular manufacturing process—must be trained under practical men in the works, and we must not imagine that a course of evening classes will convert him into an expert chemist. The ideal man who combines high scientific training and sound practical knowledge can not be produced unless the period of his education is extended to half a lifetime, and even then only through the cooperation of the chemistry teacher and the manufacturer.

The great proportion of the original work now done in this country, judging from the published records, is absolutely free from any utilitarian bias; the time, brain-power and money devoted to this work are considerable, and the results from a scientific

[1] *Ber.*, 1900, I., lxxi.

point of view eminently satisfactory. If even a fraction of the same skill and energy were brought to bear under proper conditions on problems of applied science, who can doubt but that the effect on our chemical industries would be one of vast importance? And yet it is the rarest possible occurrence to find any record of research work undertaken with a commercial object even in the natural home of such records, the *Journal of the Society of Chemical Industry*.

One reason for this may be that the discoveries made in the works-laboratories are not given to the world at large, but are quietly and lucratively applied in some secret manufacturing process. Another reason, unfortunately the more probable one, may be that nearly all the principal research workers are completely shut off from any industrial influences.

Now the worker in pure science, unaided by the advice of the manufacturer and business man, has little chance of solving any important technological problem, except as the result of accident; he has not the requisite acquaintance with commercial conditions, does not realize the enormous difference between operations on the laboratory and the manufacturing scales, or, if he does so, is unable to enter fully and with confidence into questions of fuel, labor and so on, which often determine the success or otherwise of a process. Further, much of the research work of direct commercial value concerns methods for reducing the cost of processes already in operation, and demands an intimate practical knowledge of these processes.

It is obvious, therefore, that, even if all the research capacity of the country were henceforth devoted to purely technical matters, any great improvement in our industries could hardly be anticipated without the active cooperation of the manufacturers.

There are other ways in which it might be possible to obtain the active cooperation of the manufacturers. Any individual or firm interested in a problem of applied science might be invited to found a temporary research scholarship at the university or other institution for the definite object of the particular problem in question. The maximum period during which such a scholarship would be tenable might be fixed beforehand, so that the financial liability of the founder would be limited and proportionate to the importance of the object in view. The holder of the scholarship might be nominated by the university, or by the founder and the university jointly, and suitable conditions would be drawn up to insure the interests of the founder; he would, of course, have the benefit of all the results of the work, and would secure the patent-rights of any new invention, subject possibly to the payment of a small percentage of the profits to the university and to the holder of the scholarship. During the tenure of the scholarship the holder, and also the founder, would have the advantage of the scientific knowledge of the university; the scholarship holder would also be allowed to gain practical experience in the works, and, if successful, there is little doubt but that he would have the option of working the process on the large scale and of obtaining permanent employment under satisfactory conditions. After a given period the scientific results of the work would be published through the usual channels in the ordinary way.

This idea of applied research scholarships had taken shape in my mind when I happened to come across a book recently published in the United States, called "The Chemistry of Commerce," in which I found that a similar proposal had been made by the author, R. K. Duncan, professor of industrial chemistry at the University of Kansas. The scheme is there worked out in some detail, and a form of legal agree-

ment to be signed by the university authorities and by the founder of the "Industrial Fellowship" is suggested.

In drawing this address to a conclusion I can not but feel that my suggestions may seem utterly inadequate to the attainment of those important results which are so greatly to be desired. If so, I can only plead that more drastic measures are hardly available, and that even under the most favorable circumstances improvement can take place only very slowly. Whatever differences of opinion may be held as to the details of any scheme for regaining our lost ground, the main lines seem to be clearly indicated. The workers in pure science must recognize that it is their duty to do all they can to promote the industrial welfare of their country; the manufacturers must concede the paramount importance of science and the impossibility of dispensing with its counsels. Guided by these principles and by a spirit of cordial cooperation, a sustained and strenuous effort on the part of the leaders of chemical industry and of chemical science can hardly fail to accomplish the end in view.

A Determination of the Rate of Evolution of Heat by Pitchblende: HORACE H. POOLE.

A spherical vacuum jacketed vessel with a narrow neck is filled with powdered and carefully dried pitchblende. The neck is filled with cotton-wool and rendered water-tight with sheet rubber, and the whole is buried in ice. The difference of temperature between the layer of pitchblende in contact with the bottom of the vessel and the ice is measured by a sensitive thermo-couple. After about a fortnight this temperature becomes steady, when the heat leakage across the walls of the vessel is equal to the heat generated by the pitchblende. The leakage depends solely on the vessel and on the difference of temperature between inner and outer walls, which is measured by the thermo-couple. The thermal conductance of the vessel is found by substituting water for the pitchblende and determining its rate of cooling. Hence the heat leakage is known, and, knowing the amount of pitchblende present, the heat evolution per gram is found.

The thermo-couple is calibrated by placing one junction in finely broken ice and the other in a mixture of broken ice and water, which can be subjected to a known pressure. The deflection caused by the resulting small change of temperature is noted, and hence sensitiveness of couple is found.

Using 560.7 grs. of pitchblende in an atmosphere of nitrogen, the temperature finally steadied at 0.0092° C. As the thermal conductance of the vessel is 5.8 calories per hour per degree difference of temperature between inside and outside, this corresponds to a heat leakage of 0.053 calorie per hour. Hence heat evolution per gram of pitchblende is 0.000094 calorie per hour. This is about twice the quantity estimated from the known amount of radium present.

Do the Radio-active Gases (Emanations) belong to the Argon Series? Sir WM. RAMSAY, K.C.B., F.R.S.

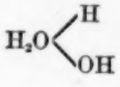
The residues of the fractionation of 120 tons of liquid air obtained from Claude were examined in the chemical laboratory of University College by Professor Moore. After removal of oxygen and nitrogen, argon, krypton and xenon remained, and were separated by methodical fractionation. The xenon amounted to about 300 $cm.^3$; it was methodically fractionated at $-130°$, and a final residue of 0.3 $cm.^3$ was obtained. The spectrum of this portion was photographed, and differed in no respect from that of xenon. It is practically certain that if this residue had contained 1 per cent. of a denser gas, that gas would have

been detected. It follows, therefore, that if there is a heavier constituent in air than xenon, its amount does not exceed $\frac{1}{25}$ billionth of the whole. Now, it is certain that if such an element existed, it would be gaseous, and would be found in air. Its non-existence implies either the absence of such elements from the periodic table or their instability. As possible atomic weights for missing elements are 178, 216 and 260, it is rendered probable that they are, respectively, unstable emanations—those of thorium, of radium and of actinium.

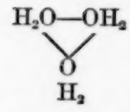
The liquid residue as obtained amounted to about 500 c.c. (500 liters gas) and in order to concentrate the noble gases was blown off into about 100 c.c. of liquid air. This liquid air which contained the accumulated noble gases was again blown off into a smaller volume of liquid air, and this process continued until a manageable quantity of liquid was obtained for fractionation.

The breaking down of the various emanations into members of the argon family was also mentioned. In the discussion that followed Professor Rutherford stated that he was repeating Ramsay's experiments on the production of neon and argon from copper salts by radium emanation and seemed to obtain different results.

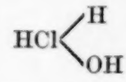
A discussion on the "Nature of Chemical Change" was opened by Professor H. E. Armstrong, F.R.S., who attacked in vigorous terms the theory of ionization in solution, propounding instead a theory of hydrogenation. From the fact that enzymes become associated with the substances they hydrolyze he concluded that acids in solution also acted as true catalysts. Water does not exist as H_2O, but as polymerized molecules, such as



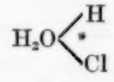
hydronol,



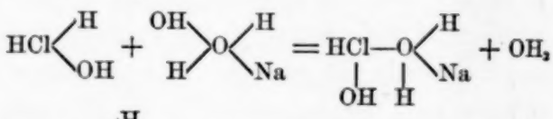
di-, tri- and polyvalohydrone. HCl dissolved in water yields $HCl{=}OH_2$ and

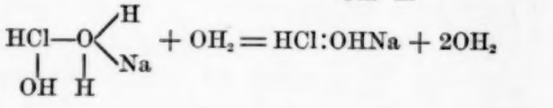


(hydrolation), and in part



which readily hydrolyzes. $H_2O{=}$ and $HCl{=}$ are active because unsaturated. In opposition to the ionic theory Professor Armstrong postulates:

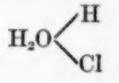
1. 

2. 

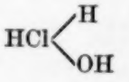
3. $HCl{:}OHNa + 2OH_2 = NaCl + 3OH_2$

and adduced in proof figures showing the volume changes after reaction.

On electrolyzing HCl in concentrated solution there are mostly present



molecules, water exerting a greater hydrolyzing effect when there is less of it present. Hence in weak solution more groups



exist and more O_2 is produced on electrolysis. The tendency for the complex molecules to produce simpler ones $(H_2O)_n \rightarrow nH_2O$ is the cause of osmotic pressure.

Of those who took part in the discussion Sir Oliver Lodge likewise expressed a preference for the attachment of water molecules to the HCl molecule, simply prefer-

ring a larger number than one, and pointing out that *then* there was little difference between the ionic theory and Professor Armstrong's.

Sir William Ramsay thought discussion was futile in view of the fact that the compounds formed by the electrons and the parts of the molecules, *e. g.*, the ions and their electric charges, had not been considered. He had thought that measurement of surface tension in mixed liquids might solve the problem, and had made a large number of such measurements, but the figures had been found absolutely inexplicable by Van der Waals and himself. The reason for this was to be found in the difference in composition between the surface layer and the interior.

Dr. Findlay pointed out that although Professor Armstrong condemned existing theories he had nothing to offer in their stead, and that he had no quantitative evidence to support the views put forward by him.

Professor Donnan in some trenchant remarks pointed out that Professor Armstrong's views were antedated by those of Werner, Bruehl and Kohlrausch.

Dr. Wilsmore remarked that according to Armstrong's theory the conductivity of a solution should vary as the square of the concentration, which like other deductions was contrary to fact.

Professor W. J. Pope stated that Professor Armstrong was really only trying to harmonize the ionic theory with the views of chemists, by picturing the process of solution by formulæ like the structural formulæ used in organic chemistry.

Sir James Dewar read a paper on "the production of helium by radium."

Quartz vessels and glass joints were used throughout; the radium was that which had been so carefully purified by Dr. Thorpe (70 mgrs.). The Crookes radiometer was used to measure minute pressures. Solid mercury warmed up to $-23°$ just again starts the Crookes' radiometer, corresponding to a pressure of $\frac{1}{50} \times 10^{-6}$ mm. The radiometer had to be washed out with oxygen prepared from potassium perchlorate.

When a McLeod gauge filled with air was attached to a tube cooled by means of liquid hydrogen to condense the air, the pressure was reduced to 0.015 mm. representing the uncondensable gas at 20° absolute. On again filling with old air (rich in residues) the pressure was 0.00051 mm. which became reduced to 0.00002 mm. on washing out with oxygen prepared from potassium permanganate. Hence it was concluded that helium and neon adhere to glass in the form of a film, and that one can be easily deceived in measuring low pressures.

When 5 milligrams of radium were connected to the radiometer it (the radiometer) became active after a few hours, although an attached tube containing charcoal was cooled by liquid air. The amount of helium produced by 70 mgrs. of radium was measured in this way, the gases produced having to traverse a U tube filled with charcoal and cooled by liquid air before reaching the McLeod gauge. After one month's experiment a yield of 0.43 c.mm. of permanent gas per gram of radium per diem was obtained, but some of the radium emanation had diffused into the McLeod gauge and acted on some organic matter or moisture, producing a higher result. On heating up the charcoal, no helium or other gas was given off.

On repeating the experiment with all care, and under the most favorable conditions (any moisture or organic matter being now evidently eliminated), the radium salt being kept one month in vacuo and the glass containers constantly heated, 0.37 c.mm. of helium per gram of radium per diem was obtained. This corresponded

almost exactly to the amount theoretically predicted by Rutherford. Cameron and Ramsay had found eight times as much.

Sir James Dewar also mentioned that some of the calculations of the Hon. J. R. Strutt, regarding the amount of radium in the earth's interior, needed revising, for one well in France produced 30 liters of helium per day, corresponding to 100 tons of radium.

Some Reactions of Dichloro Urea: F. D. Chattaway, D.Sc., F.R.S.

Urea is so well known and has been so much investigated that any new simple substance obtainable from it possesses quite an unusual amount of interest. Such a new substance is found in dichloro urea, which, leaving out of consideration the derivatives of ammonia itself, is one of the simplest possible compounds containing halogen attached to nitrogen. It is produced when chlorine is passed into a cooled saturated aqueous solution of urea. Action takes place without any considerable development of heat, and dichloro urea crystallizes out as a white powder consisting of small transparent plates. Dichloro urea gives all the characteristic reactions of a typical nitrogen chloride; for instance, it liberates iodine from hydriodic acid, chlorine from hydrochloric acid, and reacts with alcohol, forming ethyl hypochlorite, urea being in all cases reformed.

A reaction which indicates the use to which dichloro urea may be put in the synthesis of simple carbon and nitrogen rings is that between it and ammonia.

When ammonia in excess is added to an aqueous solution of dichloro urea, hydrolysis, accompanied by liberation of nitrogen and formation of carbonate, occurs, but in addition diurea is produced, and separates in considerable quantity as a sparingly soluble crystalline powder. This is the first direct synthesis of diurea from urea itself, the compound having been previously obtained from ethyl carbonate and hydrazine.

This adds another to the very few reactions known by which nitrogen atoms can be made to link up together, and further affords an exceedingly simple synthesis of hydrazine.

Diurea, when heated with excess of strong sulphuric acid to a little above 100° C., is easily hydrolyzed, carbon dioxide escapes, and hydrazine sulphate is produced. This crystallizes out perfectly pure in almost theoretical amount on cooling and adding a little water.

The Factors which Influence the Rate of Acoholic Fermentation: Arthur Slator, Ph.D., D.Sc.

The transformation of glucose into alcohol and carbon dioxide by the action of yeast is probably not a single chemical reaction but a series of reactions. If one reaction of the series proceeds relatively much more slowly than the others, then the velocity of the transformation is determined by the rate of this slow reaction.

Evidence is brought forward to show that the initial rate of fermentation by living yeast is controlled almost completely by one single reaction.

The rate of fermentation is exactly proportional to the amount of yeast present. The rate of fermentation of the four fermentable hexoses (glucose, fructose, galactose and mannose) is almost independent of the concentration of the sugar. Glucose and fructose are fermented at approximately equal rates. The fermentation of mannose is similar to that of glucose, but the rates of the two reactions are not equal. The enzyme which ferments mannose seems to be more sensitive to heat than the one which ferments glucose. The influence of temperature on these reac-

tions is almost the same in the case of glucose, fructose and mannose, but rather less in the case of galactose. These results are most easily brought into accord on the assumption that the enzyme combines with the sugar.

Fermentation by yeast-juice differs in many respects from that by living yeast. It is probable that the mechanism of the reaction is the same in each case; but the relative rates of the different steps in the two processes are different. The experiments show that there is an essential step in fermentation in which phosphates in some form or another play a part.

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(To be concluded)

SIXTEENTH INTERNATIONAL CONGRESS OF AMERICANISTS

THE Sixteenth International Congress of Americanists was held in Vienna from Septemper 9 to 15. The congress was well attended, particularly by students from South America. Representatives were also present from Russia, Sweden, Denmark, Germany, England, Holland, Belgium, France, Spain and Italy. The attendance of ethnologists from the United States was not as great as might have been desired.

Owing to the presence of a considerable number of South Americans, many of the subjects discussed before the congress related to the archeology of that continent. Mexican archeology was also well represented; while the ethnology and archeology of North America, which at the Fifteenth Congress of Americanists played a particularly important part, was hardly discussed at all. Following is a list of the papers read before the congress:

Franz Boas (New York), opening address, "The Results of the Jesup Expedition."

Sir Clements Markham (London), "Some Points of Interest in the History of the Incas by Sarmiento."

William Thalbitzer (Copenhagen), "The Angakoks or Pagan Priests of the Eskimos of Ammasalik, East Greenland."

Paul Ehrenreich (Berlin), "Über unsere gegenwärtige Kenntnis der Ethnographie Südbrasiliens."

Franz Ritter von Wieser (Innsbruck), "Die Weltkarte des Pierre Destelier von 1553, im Besitze Seiner Exzellenz des Grafen Hans Wilczek."

Franz Heger (Vienna), "Die archäologischen und ethnographischen Sammlungen aus Amerika im k. k. naturhistorischen Hofmuseum in Wien."

Antonio Sanchez Moguel (Madrid), "Intervención de Fray Hernando de Talavera en las negociaciones de Colón en los Reyes Católicos."

Adela C. Breton (Montreal, Canada), "Exhibition of a Copy of the Ancient Plan in the Museo Nacional, Mexico, supposed to be Part of a Plan of Tenochtitlan."

Jean Denucé (Uccle-Brussels), "Une grande carte de l'Amérique, par les Reinel (vers 1516)."

Manuel M. de Peralta (Paris), "Sur les aborigènes et la cartographie de l'Amérique Centrale et spécialement de la région comprise entre la 8° et le 15° de latitude Nord."

Ignacio Moura (Paris), "Sur le progrès de l'Amazonie et sur ses indiens."

J. Kollmann (Basel), "Kleine Menschenformen unter den eingeborenen Stämmen von Amerika."

Robert Lehmann-Nitsche (La Plata), "Zur physischen Anthropologie der westlichen Chacostämme."

A. Wirth (Munich), "Die Autobiographie Franz Urban Rawiers (um 1720)."

Sir Clements Markham (London), "A Comparison of the Ancient Peruvian Carvings on the Stones of Tiahuanaco and Chavin."

Professor Dr. Capitan (Paris), "Les grands anneaux de poitrine des anciens Mexicains. Comparaisons avec les anneaux japonais, chinois, océaniens et les pièces similaires préhistoriques de la Gaule."—"L'entrelac cruciforme dans l'antiquité américaine, au Japon, en Chine, aux Indes et en Gaule."—"L'omichicahuatzli mexicain et son ancêtre de l'époque du renne Gaule."

J. D. E. Schmeltz (Leiden), "Die niederländische Tumac Humac-Expedition in Surinam."

L. C. van Panhuys (The Hague), "A Remarkable Book on the Indian Mind."—"Communications about Ethnography and History of Surinam."

Heinrich Pabisch (Vienna), "Der Fischfang mit Giftpflanzen in amerikanischen Gewässern."

Marshall H. Saville (New York), "Archeological Researches on the Coast of Esmeraldas, Equador."

Stansbury Hagar (New York), "The Elements of the Maya and Mexican Zodiacs."

K. Th. Preuss (Berlin), "Das Fest des Weines bei den Cora-Indianern der mexikanischen Sierra Madre Occidental."

Eduard Seler (Berlin), "Die Ruinen von Chich'en-Itzâ in Yucatan."—"Die Sage vom Quetzalcouatl und den Tolteken nach den in neuerer Zeit bekannt gewordenen Quellen."

George Grant MacCurdy (New Haven, Conn.), "The Alligator in the Ancient Art of Chiriqui."

L. Wollmar (Heidelberg), "Die mexikanischen Bilderschriften und die Zuverlässigkeit ihrer alten und ihrer neueren Interpretationen."

Juan B. Ambrosetti (Buenos Aires), "La question Calchaquie et le travaux de la Faculté de philosophie et lettres de l'Université Buenos Aires."

Max Uhle (Lima), "Uber die Frühkulturen der Umgebung von Lima."—"Zur Deutung der Intihuatanas."—"Uber Muschelhügel in Peru."

Enrico Giglioli (Firenze), "Intorno a due rari cimeli precolombiani dalle Antille; molto probabilamente da San Domingo."—"Di certi singolari pettorali di pietra e di conchiglia precolombiani, dalla Venezuela."

Eduard Seler (Berlin), "Der altmexikanische Federschmuck des k. k. naturhistorischen Hofmuseums. Bericht über eine Untersuchung seiner Konstruktion und Beschaffenheit."

Julius Nestler (Prague), "Ein von dem österreichischen Konsul in Managua (Nicaragua) gefundenes Idol."—"Die Ruinenstätte von Tiahuanaco in Bolivia und ihre Bedeutung."

Professor Sakaki (Kioto), "Une nouvelle interpretation du pays 'Fou-sang.'"

Alberto Frič, "Völkerwanderungen, Ethnographie und Geschichte der Conquista in Südbrasilien."

Adela C. Breton, "Survivals of Ceremonial Dances amongst the Indians in Mexico."

Charles Peabody (Cambridge, Mass.), "Recent Cave-work in America."

C. V. Hartmann (Stockholm), "Some Features of Costa Rican Archeology."—"The Photographon, an Instrument which will replace the Grammophon."

Barbara Klara Renz (Breslau), "Elternliebe bei amerikanischen Stämmen."

Rudolf Trebitsch (Vienna), "Ethnographisches aus Westgrönland, mit Vorführung von Lichtbildern und Phonogrammen."

Richard Wallaschek (Vienna), "Uber den Wert phonographischer Aufnahmen von Gesängen der Naturvölker."

William Thalbitzer (Copenhagen), "Demonstration von Lichtbildern der heidnischen Kultur der Ostgrönländer nebst Erläuterungen."

A. G. Morice, O.M.I. (Kanloops, British Columbia), "Le verbe dans les langues Dénées."

Jean Denucé (Uccle-Brussels), "Note sur un vocabulaire complet de la langue Yahgane (Terre de Feu)."

A. Wirth (Munich), "Die Theorie Trombettis von dem Zusammenhang amerikanischer und asiatischer Sprachen."

P. Fr. Hestermann, S.V.D. (Mödling), "Über die Pano-Sprache und ihre Beziehungen."

P. W. Schmidt (Mödling), "Zur Phonologie der amerikanischen Sprachen und ihrer Transkription."

The Ethnographical Museum of Vienna had arranged a special exhibit of its valuable collections relating to America. Among the specimens shown, the precious relics of the Conquista, which were originally preserved at Ambras Castle, were of greatest interest. The museum had also prepared for the congress a special account of the history of its growth. Among other publications presented to the congress were that of the Islario General of Alonso de Santa Cruz by Dr. Franz Ritter von Wieser; the third volume of the collected essays by Professor E. Seler; the account of the Surinam Expedition of the Dutch Government by C. H. de Goeje, published by Dr. Schmeltz; the first volume of the Publications of the American Ethnological Society, of New York, containing the Fox Texts collected by Dr. William Jones; and the important publications on the archeology of Mitla, by Leopoldo Batres.

The social arrangements were exceptionally good, and enabled the members of the congress to spend the week profitably and enjoyably. On Sunday, September 14, the congress, following an invitation by Count Wilczek, visited Kreuzenstein Castle, with

its valuable treasures illustrating the industries and arts of the middle ages.

The general impression left by the congress in regard to the local status of anthropological studies in Vienna is encouraging. The valuable material contained in the Imperial Museum, so far as it is accessible, is well arranged, and a healthy growth of the museum in every direction is apparent. It is particularly worth remarking that the study of the prehistoric remains of Austro-Hungary and that of the folk industries and customs of the empire are closely connected, and that both seem to be pursued with wisdom and energy. The wealth of material exhibited in the Museum für Völkerkunde is a proof of the interest excited by this subject. As in all ethnographical museums of Europe, the room for additional space is keenly felt, and it is understood that a new ethnographical building will be provided in the near future.

Considering the amount of work done in all these directions, it is surprising that the university has not seen fit yet to establish a chair of ethnology and of physical anthropology. It would seem that in a country like Austria, where the problems arising from the conflicting interests and diversity of characteristics of nationalities are ever present, the need of university instruction in the science of ethnology would early be felt, and it seems difficult to understand, at least from the point of view of American university organization, why, in the largest university of Austria, the whole field of anthropology should still be unrepresented.

The program of the congress shows that the restriction of its field of work to America hampers its usefulness to a certain extent; and the question may well be asked, whether the time has not come to expand the program of the Congress of Americanists in such a way as to make it the starting-point for an International Ethnological Congress. The number of students of America is limited, and many of the problems with which we are dealing can be understood only from a wider ethnological point of view. For this reason the meeting of Americanists conjointly with students of Africa, Polynesia and other countries inhabited by primitive people, and arranged in sections analogous to sections of other large congresses, would seem to become a necessity.

The next congress will be held in 1910, the centennial of the establishment of the Argentine Republic and of Mexico. For this reason the congress has deemed it wise to accept the urgent invitations of these two countries, and to have two meetings in 1910—in May, in Buenos Aires; and in September, in Mexico. In order to preserve the continuity of organization, Buenos Aires has been selected as the center of organization of this session.

FRANZ BOAS

THE FOURTH INTERNATIONAL FISHERY CONGRESS

THE Fourth International Fishery Congress met in Washington on September 22, 1908, in response to an invitation extended by the Bureau of Fisheries on behalf of the United States government; the American Fisheries Society also joined in the invitation. The official auspices under which the meeting was held were further shown by an appropriation made by congress for defraying the legitimate expenses of the gathering. This series of congresses was organized and inaugurated at Paris in 1900, the intervening meetings being held in St. Petersburg (1902) and Vienna (1905).

The foreign delegates gathered at the Department of State on the morning of the twenty-second, and were greeted by the acting secretary, Mr. Adee. The opening meeting was held at the hall of the National Geographic Society, Hon. George M. Bowers, U. S. Commissioner of Fisheries, presiding. Ad-

dresses of welcome were made by Hon. Oscar S. Straus, secretary of commerce and labor, on behalf of the United States; by Hon. Henry L. West, commissioner of the District of Columbia, on behalf of the City of Washington; and by Dr. Hugh M. Smith, president of the American Fisheries Society, on behalf of the society. A response in the name of the foreign delegates was made by Dr. P. P. C. Hoek, scientific fishery adviser of the Dutch government. The nomination of Professor Hermon C. Bumpus as president of the congress and of Dr. Hugh M. Smith as secretary-general was ratified, and fifteen vice-presidents from different countries represented were elected. Thereafter two sessions were held daily, the final meeting being on the afternoon of the twenty-fifth.

The membership of the congress was larger than at the two previous meetings, numbering more than 400. Fifteen countries were represented by official delegates, and 11 other countries by delegates of societies and by private individuals. In addition to a number of delegates at large on behalf of the United States government, four executive departments and the U. S. National Museum and Smithsonian Institution were officially represented. There were also duly appointed delegates from 43 American states and territories and 20 American societies, clubs and institutions. There were in attendance many of the leading fishery workers of the world, and as a whole the gathering was more noteworthy from the standpoint of personnel than any similar meeting ever held in the western hemisphere.

There were presented a large number of papers of exceptional merit and covering nearly every phase of commercial fishing, fishery legislation, aquiculture, acclimatization and scientific investigation of aquatic problems. Many of the papers were submitted in competition for the 18 cash prizes aggregating $2,200 offered by various institutions and individuals. The international jury appointed for the purpose made the following awards:

By the American Museum of Natural History, New York City: For an original paper describing and illustrating by specimens the best method of preparing fishes for museum and exhibition purposes. $100 in gold. Awarded to Dwight Franklin, New York, N. Y.

By the Museum of the Brooklyn Institute of Arts and Sciences, Brooklyn, New York: For the best paper setting forth a plan for an educational exhibit of fishes, the species and specimens that should be shown, the method of arrangement, and suggestions for making such an exhibit instructive and attractive. $100 in gold. Equally divided between Frederic A. Lucas, Museum of the Brooklyn Institute of Arts and Sciences, and Roy W. Miner, American Museum of Natural History.

By the Smithsonian Institution, Washington, D. C.: For the best essay or treatise on "International regulations of the fisheries on the high seas, their history, objects and results." $200 in gold. Awarded to Charles H. Stevenson, Bureau of Fisheries, Washington, D. C.

By the United States Bureau of Fisheries, Washington, D. C.: For a report describing the most useful new and original principle, method or apparatus to be employed in fish culture or in transporting live fishes (competition not open to employees of the bureau). $200 in gold. Awarded to Dr. A. D. Mead, Brown University, Providence, Rhode Island.

By the Wolverine Fish Company, Detroit, Michigan: For the best plan to promote the whitefish production of the Great Lakes. $100 in gold. Awarded to Paul Reighard, University of Michigan, Ann Arbor.

By Mr. Hayes Bigelow, Brattleboro, Vermont, member of the American Fisheries Society: For the best demonstration, based on original investigations and experiments, of the commercial possibilities of growing sponges from eggs or cuttings. $100 in gold. Awarded to Dr. H. F. Moore, Bureau of Fisheries, Washington, D. C.

By Dr. H. C. Bumpus, director of the American Museum of Natural History, New York City: For an original and practical method of lobster culture. $100 in gold. Awarded to Dr. A. D. Mead, Brown University, Providence, Rhode Island.

By Mr. John K. Cheyney, Tarpon Springs, Florida, member of the American Fisheries Society: For the best presentation treating of the methods of the world's sponge fisheries, the influence of such methods on the supply of sponges, and the most effective means of conserving the sponge grounds. $100 in gold. Awarded to Dr. H. F. Moore, Bureau of Fisheries, Washington, D. C.

By Professor Theodore Gill, honorary associate

in zoology, Smithsonian Institution, Washington, D. C.: For the best methods of observing the habits and recording the life histories of fishes, with an illustrative example. $100 in gold. Awarded to Dr. Jacob Reighard, University of Michigan, Ann Arbor.

By Dr. F. M. Johnson, Boston, Massachusetts, member of the American Fisheries Society: For the best demonstration of the comparative value of different kinds of foods for use in rearing young salmonoids, taking into consideration cheapness, availability and potentiality. $150 in gold. Awarded to Charles G. Atkins, superintendent U. S. Fisheries Station, East Orland, Maine.

By the New York Academy of Sciences, New York City: For the contribution, not entered in competition for any other award, which shall be judged to have the greatest practical value to the fisheries or fish culture. $100 in gold. Awarded to John I. Solomon, New York City, for a paper describing a process for preserving pearl-oyster fisheries and for increasing the value of the yield of pearls therefrom.

For the other prizes there was either no competition or the papers were not adjudged to be of sufficient merit.

Among the resolutions and views adopted by the congress were the following: (1) Expressing pleasure that the long-standing fishery dispute between the United States and Great Britain affecting waters on the northeast coast of North America is to be submitted to settlement by arbitration; (2) commending the President of the United States for his stand in behalf of the conservation of natural resources; (3) advocating the establishment, in all countries having important fisheries, of national schools of fisheries and fish culture under government auspices; (4) urging the necessity of simplifying fishery laws by the elimination of qualifying clauses which often provide loopholes through which offenders may escape penalties and waters remain unprotected; (5) favoring the formation of the Appalachian Forest Reserve and other similar reserves which embrace the headwaters of important streams; (6) advocating uniform measures on the part of the United States and Canada for the extermination or utilization of the dogfishes, in view of the great injury done thereby to the fishing industry; (7) reaffirming the action of former International Fishery Congresses in recommending an international oceanographic exploration of the Mediterranean in the interests of the fisheries; (8) endorsing the proposition to issue a condensed international dictionary of fisheries and fish culture, in which will be found in twelve or fourteen languages the names of the most important commercial fishes, fishing gear, fishing craft, fishery products, etc., weights and measures used in the fish trade, fish-cultural termini technici, etc.

Among the many pleasant events occurring during the week of the congress were a reception by the President of the United States (who was the honorary president of the congress); a reception by the secretary of Commerce and Labor; a visit to the Library of Congress, where there was a special display of fishery literature; complimentary luncheons tendered by the American Fisheries Society, the Alaska Packers' Association, and the Blue Ridge Rod and Gun Club; special exhibits of fishing craft and of specimens of fishes and reptiles at the National Museum, and of living fishes, hatching operations, and apparatus and products of the fisheries at the Bureau of Fisheries; a display of moving pictures of fishing, hunting, and logging scenes, through the courtesy of the New England Forest, Fish and Game Association, many of the views being then shown for the first time; and a banquet at which the foreign delegates were guests of honor.

The congress accepted the invitations of the Italian Fisheries Society and the City of Rome to hold the next meeting in Rome in 1911, the fiftieth anniversary of the unification of Italy.

MEMORIAL EXERCISES IN HONOR OF WILLIAM F. VILAS

MEMORIAL exercises in honor of William F. Vilas were held in the Armory at the University of Wisconsin on October 20. The audience, which numbered nearly 5,000, consisted of regents, faculty, students and alumni of the university, and citizens of Madison. Ex-Governor W. D. Hoard spoke on behalf of the regents; Chief Justice J. B. Winslow for

the state; Professor B. W. Jones for the college of law; and President C. R. Van Hise on behalf of the university.

After reviewing Colonel Vilas's almost continuous connection with the university in one capacity or another from the time that he entered as a preparatory student in 1852, until his death fifty-six years later, and after pointing out the great service which he rendered his alma mater as a regent as well as a professor of law, President Van Hise spoke of the significance of the endowment of over $30,000,000, from the Vilas will. President Van Hise said:

The benefits of Colonel Vilas's will are likely to influence the development of the university long before financial advantages are received. Those who are striving for the construction of the university along the highest as well as the broadest lines now have the powerful moral support of one of the ablest and most distinguished citizens that have ever lived in this state, of the man who by long study of educational problems in the university has the best right to speak as to its future. The will of Colonel Vilas is not merely a deed of gift to the university; it is a gift of his highest thought, matured through years of consideration of the educational problems of this state. It is, indeed, possible that this gift of his mind may be even greater in its influence on the development of the university than the gift of his property. Thus Colonel Vilas's will is not merely a financial bequest; it is a profound state paper which is certain to influence perpetually the development of higher education in this commonwealth.

President Van Hise explained that the will provides: first, for a theater, as a memorial to the beloved son, Henry Vilas, who was graduated at the university in 1894, but who died at an early age; second, after providing for this memorial half of the income goes for scholarships and fellowships, for the support of art and music, and for the maintenance of ten research professorships with adequate salaries and assistants. He said:

There can be no broader statement of endowment for research than that of the Vilas will. "These professorships," the will reads, "are designed to promote the advancement of knowledge rather than to give instruction; not more than three hours a week, nor more than one hour in one day shall be exacted of the incumbent for teaching, lecturing, or other instruction to students or otherwise. Any branch of human learning may be selected as a subject for special study." "The university may best be raised to the highest excellence as a seat of learning and education," the will continues, "by abundant support in pushing the confines of knowledge: the special object of this trust."

As Dr. Van Hise points out:

These research professorships, while not first in order, are placed "first in importance among the purposes of the trust." The provisions for their support, including liberal salaries, assistants, materials, a limited amount of instructional work, and relations with students, are an epitome of the situation in the best German universities, which are admitted to stand first among the institutions of the world in the advancement of knowledge. The accumulated university wisdom of the past century Colonel Vilas has concentrated in this great document for the advancement of knowledge.

THE DARWIN ANNIVERSARY MEETING OF THE AMERICAN ASSOCIATION

The program for the Darwin Anniversary meeting of the American Association is now practically complete. The following have accepted the committee's invitation to present papers on the subjects given:

T. C. Chamberlin: Introductory remarks as president of the association.

Edward B. Poulton: "History of the Theory of Natural Selection since Darwin."

J. M. Coulter: "The Theory of Natural Selection from the Standpoint of Botany."

D. T. MacDougal: "The Direct Effect of Environment."

C. O. Whitman: "Determinate Variation."

C. B. Davenport: "Mutation."

W. E. Castle: "The Behavior of Unit Characters in Heredity."

D. S. Jordan: "The Isolation Factor."

C. H. Eigenmann: "Adaptation."

E. B. Wilson: "The Cell in Relation to Heredity and Evolution."

G. Stanley Hall: "Evolution and Psychology."

H. F. Osborn: "Recent Paleontological Evidence of Evolution."

These papers, which will probably be presented on Friday, January 1, will be published in a memorial volume. A dinner will be held

in the evening at which less formal speeches will be made.

SCIENTIFIC NOTES AND NEWS

PROFESSOR H. F. OSBORN will deliver the third series of the "Norman W. Harris Lectures" before Northwestern University, from December 3 to 11. The subject of the course is "The Age of Mammals in Europe and America." The lectures treat of the Cænozoic period faunistically and from the standpoint of migrations between the old and the new worlds. According to the conditions of the lectureship they will be published subsequently in book form.

DR. THEOBALD SMITH, professor of comparative pathology in the Harvard Medical School, will give a course of eight Lowell lectures on "Our Defenses against the Microorganisms of Disease." These lectures, beginning March 16, will be given on Tuesdays and Fridays.

THE non-resident lecturer in mathematical physics at Columbia University for the year 1908–9 is Professor Max Planck, of Berlin. In the latter part of April and the early part of May, 1909, he will deliver a course of lectures upon "The Present System of Theoretical Physics," dealing particularly with the questions of reversibility, heat-radiation, and the principle of relativity. Details of the dates and subjects of the individual lectures will be published early in March.

PROFESSOR BATESON delivered an inaugural lecture at Cambridge University on October 23, on "The Methods and Scope of Genetics."

DR. WILLIAM P. MASON, professor of chemistry at the Rensselaer Polytechnic Institute, of Troy, N. Y., gave the annual Founders' Day address at Lafayette College, on October 21, his subject being "A Plea for a wider and better Extension of the Knowledge of Sanitary Science. The degree of LL.D. was conferred upon Professor Mason.

IN connection with the visit of the members of the Congress of Electrical Units to Cambridge University, degrees of doctor of science were conferred on Dr. S. W. Stratton, Professor Svante A. Arrhenius, Professor G. Lippmann and Dr. E. G. Warburg.

MR. W. H. HOLMES, chief of the Bureau of American Ethnology, sailed for South America on October 28, as delegate of the United States to the Pan-American Scientific Congress. He will return in February. During his absence Mr. F. W. Hodge will be in charge of the bureau.

IN accordance with the current federal agricultural appropriation act, authorizing the establishment of an experiment station in the Island of Guam, Dr. W. H. Evans, of the Office of Experiment Stations, has visited the island and selected a site for the station at Agaña. The station will be conducted under the immediate supervision of the office, with H. L. V. Costenoble as agent in charge.

SIR DANIEL MORRIS, Imperial Commissioner, West Indian Agricultural Department, has resigned.

MR. ROSWELL H. JOHNSON has resigned his position as investigator at the Station for Experimental Evolution of the Carnegie Institution at Cold Spring Harbor, N. Y., to become a consulting geologist. His manuscript on "Determinate Evolution in the Color Pattern of the Lady Beetles" is now in press.

DR. I. F. LEWIS has returned from Europe, where he has been studying at Naples and Bonn, and has resumed his duties as professor of biology at Randolph-Macon College, Ashland, Va.

SIR JAGADIS CHANDRA BOSE, M.D. (Cantab.), D.Sc. (Lond.), professor of the Presidency College, Calcutta, addressed the Biological Club of the Massachusetts Institute of Technology on October 22. His subject was "The Plant as a Living Machine," and the lecture was followed by a demonstration of plant responses, mechanical and electrical.

THE 347th regular meeting of the Middletown Scientific Association was held in the Scott Laboratory of Physics, Wesleyan University, on October 27, when Professor Herbert William Conn delivered an address on "The Fight against Tuberculosis."

A MEETING of the Columbia Chapter of the Society of Sigma Xi was held with the department of physics, on October 29. The

lecture of the evening was upon the subject "Modern Practise in Color Photography," and Mr. Alfred Norton Goldsmith, B.S., the lecturer, described and illustrated by apparatus and specimens the present methods of producing color photographs.

Dr. William R. Brooks, director of Smith Observatory and professor of astronomy at Hobart College, lectured recently at Wells College on "Other Worlds than Ours." The lecture was illustrated with stereopticon views and motion slides.

A meeting of trustees, faculty, students and alumni, to commemorate the life and work of the late Dr. D. C. Gilman, formerly president of Johns Hopkins University, will be held in McCoy Hall on the afternoon of Sunday, November 8.

Dr. Adolph Wüllner, professor of physics at Aachen, died on October 6, at the age of seventy-three years.

The deaths are also announced of Dr. A. W. Pöhl, professor of chemistry at St. Petersburg, at the age of fifty-eight years, and of Dr. Lissauer, of Berlin, known for his work in anthropology.

The Astronomical and Astrophysical Society of America will hold its next meeting, in the summer of 1909, probably at the Yerkes Observatory. The exact date has not yet been fixed, but it is expected to precede by a few days the Winnipeg meeting of the British Association for the Advancement of Science, which will open on August 25, 1909.

The steamer *Pourquoi Pas,* with the Charcot Antarctic exploration expedition on board, arrived at Rio Janeiro on October 12, on its way to the South Polar regions, according to press dispatches. The ship will remain there for a week and the Geographical Society will give a reception in honor of the scientific staff. It will then proceed down the South American coast to Buenos Ayres, Punta Arenas and Ushushia, in Patagonia. Dr. Charcot will visit Loubet Land, which he discovered in 1905, and from that point will proceed to Alexander Land.

A meeting of the Geographical Society of Philadelphia will be held at Witherspoon Hall at eight o'clock on Wednesday evening, November 4, when the program will be:

Annual address by the President: Mr. Alba B. Johnson.

"Movement for the Conservation of Natural Resources": Mr. Emory R. Johnson.

"Report on the Ninth International Geographical Congress": Mr. Henry G. Bryant.

The program of the Forest Club of the University of Nebraska for the first semester of the academic year is as follows:

October 6—"Poplars and their Importance": Dr. Bessey.

October 20—"Influence of Windbreaks": C. R. Tillotson.

November 3—"Forest Surveys": Professor Sears.

November 17—"Gypsy and Brown-tail Moths": Professor Bruner.

December 1—"Germination of Forest Seed": Mr. McNeel.

December 15—"Forest Methods in the Rockies": H. Stephenson and H. Greenamyre.

January 6—"Problems in Forest Ecology": Mr. Pool.

At the recent meeting of the British Iron and Steel Institute Professor E. D. Campbell, of the University of Michigan, presented a paper on the constitution of carbon steels. According to an abstract in *Nature* he reviewed the efforts that have been made to interpret the phenomena of the hardening and tempering of steel in the light of the phase rule. The analysis of the carbides obtained from martensite and from troostite in his laboratory appears to indicate marked dissociation, ionic as well as molecular, in the carbides from martensite, while the analysis of the carbides obtained from troostite would seem to indicate almost complete association and polymerization of the dissolved carbides, since the nitro-derivatives of the troostitic carbides are as dark in color as those obtained from equal amount of carbides derived from pearline. These results would indicate the probability that when martensite is heated from 0° C. to 200° C. there is progressive association of ionically dissociated carbides, and polymerization of the carbides of lower molecular weight into those of high molecular weight. This polymerization of dissolved carbides is apparently complete by the time

the metal has been converted into troostite. This conception of the changes which take place in the gradual conversion of martensite into troostite offers a simple and rational explanation of the progressive darkening of martensite with rising temperature from 0° C. to 200° C., and for the increase of what Heyn and Bauer term free carbon, but which is probably a condensation product of olefines of high molecular weight. It is suggested that there does not seem to be any inherent reason why the complete substitution of hydrogen by iron should prevent carbon atoms from assuming relations to each other similar to those which they hold in hydrocarbons. The conception of the carbon compounds of iron as metallic derivatives of hydrocarbons suggests a possible explanation of many unsolved problems in the metallurgy of steel, as, for instance, how other elements, too small in amount in themselves to affect profoundly the properties of the steel, may enter into the carbon compounds and, by altering their constitution, bring about effects on the steel as a whole entirely out of proportion to the amount of the element present.

AT a convention at the University of Illinois to consider means of combatting tuberculosis in cattle, in session on October 13 and 14, the methods followed successfully by the college of agriculture of the University of Wisconsin will be discussed with a view to adopting them in the state of Illinois. The prevalence of the disease in Illinois is believed to be as great as it was in Wisconsin several years ago when the present plan of testing all dairy herds and segregating or destroying the tuberculous was adopted. Dean H. L. Russell, of the Wisconsin Agricultural College, delivered a lecture and post-mortem demonstration of the effects of the disease upon cattle.

WE learn from the London *Times* that with the view of increasing the public utility of the collection of specimens contained in the museum of the Royal College of Surgeons, the council of the college has arranged for a series of demonstrations to be given in the theater of the college during the present session. The demonstrations will be given by the conservator, Professor Keith, and by the pathological curator, Professor Shattock. Specimens from the museum will be shown, and their bearings on general and surgical pathology discussed. The demonstrations, besides being of practical value to medical practitioners and advanced students, should also be of assistance to visitors of the college museum. The first demonstration of the series was to be given by Professor Keith on October 16, which is the one hundred and fifteenth anniversary of the death of John Hunter, the founder of the museum.

THE program of the Harvey Society for its course of lectures during the winter of 1908–9 is as follows:

October 24—"Intestinal Infection and Immunity in Tuberculosis": Professor A. Calmette, director of the Pasteur Institute of Lille, France.

November 7—"Fever": Professor W. G. MacCallum, Johns Hopkins University.

November 21—"Metabolism in Diabetes": Professor Graham Lusk, University and Bellevue Medical College.

November 28—"Therapeutics of Diabetes": Dr. Wilhelm Falta, University of Vienna.

December 5—"Anaphylaxis": Dr. M. J. Rosenau and Dr. John F. Anderson, United States Public Health and Marine Hospital Service.

December 19—"Osmosis": Professor A. B. Macallum, University of Toronto.

January 9—"The Relation of the Liver to the Metabolism of Fat": Professor J. B. Leathes, Lister Institute of Preventive Medicine, London.

February 6—"Some Problems in Immunity and the Treatment of Infectious Diseases": Professor Philip Hanson Hiss, Columbia University.

March 6—"Heredity in Man": Dr. C. B. Davenport, Station for Experimental Evolution, Cold Spring Harbor, N. Y.

The lectures are given under the patronage of the New York Academy of Medicine, on Saturday evenings at 8:30, at the Academy of Medicine, 17 West Forty-third Street.

ACCORDING to a notice in the *Journal of the American Medical Association,* the second meeting of the International Association of Medical Museums was held in Washington, October 1 and 2. Dr. William G. MacCallum, Baltimore, was elected president; Dr. Sims

Woodhead, Cambridge, vice-president; and Dr. Maud E. Abbott, Montreal, secretary-treasurer. It was decided to publish a bulletin and an editorial committee consisting of Drs. Aldred S. Warthin, Ann Arbor, Mich.; Dr. Aschhoff, Freiburg, Germany; and Dr. Frederick F. Russell, Washington, with the president and secretary ex-officio, was appointed. Among the subjects discussed at the meeting were "The Exchange of Specimens," "Elevation of the Medical Museum as a Teaching Medium," "Index Pathologicus," "Classification of Specimens," and "Methods of Technic." The next meeting of the association will be held in Boston in April next, following the meeting of the Association of American Pathologists and Bacteriologists.

Along the lines of the Erie Railroad in western New York a train will be run this fall by the New York State College of Agriculture at Cornell. The train will be known as the "Educational Special." On board will be about a dozen senior members of the agricultural faculty. At each station, where a stop of forty-five minutes will be made, the professors will talk to the farmers and answer any questions that may be asked by seekers for information about improved methods of farming. Circulars and posters will be sent in advance, so that the exact time of the arrival of the train may be known. Towns on the main line, the Rochester division and the Hornell and Attica division and their branches will probably be visited and the party will be on the road about ten days.

As a result of recent cooperative work with the state board of health of Rhode Island, the United States Geological Survey has accumulated a large amount of data in regard to textile and other factory wastes, the processes which produce them, their effects on streams into which they may flow, and methods by which their deleterious effects may be reduced to a minimum. This information will soon be made available to the general public through the medium of one of the survey's water-supply papers. The factory wastes studied in detail are those resulting from wool scouring, cotton-yarn bleaching, cotton-yarn dyeing, and cotton-cloth bleaching, and from the manufacture of fertilizer, glue and oleomargarine. Experimental purification of the wastes was undertaken with varying results. The details of the experiments, with estimates of probable cost and degree of purification, will be given in full in the forthcoming paper. It was found that all the wastes studied can be satisfactorily purified at a reasonable expense. The sewage from the manufacture of fertilizer, glue and oleomargarine contains enough valuable matter to pay the costs of treatment, and the recovery of wool fat and potash from wool-scouring liquor will in many cases result in a substantial profit. The pollution of streams and consequent destruction of natural water resources by such liquid wastes therefore seems to be unwarranted.

UNIVERSITY AND EDUCATIONAL NEWS

A bill has been introduced in the Vermont legislature appropriating $6,000 annually for the establishment of a department of pedagogy in Middlebury College.

Professor Liveing has given to Cambridge University almost the whole of the apparatus and material belonging to him in the chemical laboratory.

The attendance at the University of Cincinnati this year, exclusive of the external students, is as follows: liberal arts, 409; engineering, 191; teachers, 191; medical, 119; law, 82; graduate, 85.

We learn from the *Experiment Station Record* that in accordance with the law passed by the first state legislature of Oklahoma providing for the establishment and maintenance of agricultural schools of secondary grade in each supreme court district of the state, two schools have been established this year, one known as the Murray State School of Agriculture, located at Tishomingo in Johnston County and the other at Warner in Muskogee County. These state schools will offer no courses of instruction other than industrial courses. Each school has an appropriation for the first year of $20,000 for buildings and $12,000 for maintenance. One fourth of the maintenance fund for each school must

be expended in developing agricultural experiments in the field, barn, orchard, shop and garden. The Tishomingo School has 120 acres of land and the Warner School, 160 acres. These and the other similar schools in the state will be under the supervision of the state commission of agricultural and industrial education, which consists of the state superintendent of public instruction, the president of the state board of agriculture and the president of the Agricultural and Mechanical College. The Murray School will open this fall and will be in session eight months.

DR. ALBERT ROSS HILL will be inaugurated as president of the University of Missouri on December 10. The principal speaker will be Dr. J. G. Schurman, president of Cornell University.

MR. R. J. H. DELOACH, botanist to the Georgia Experiment Station, has resigned to accept a professorship of cotton industry in the State Agricultural College at Athens.

THE following appointments have been made in the philosophical department of the University of Michigan: DeWitt H. Parker, Ph.D. (Harvard) to be instructor in philosophy; F. C. Dockeray, A.B. (Mich.), and Elmer C. Adams, A.B. (Mich.), to be assistants in psychology.

INSTRUCTORS at the University of Cincinnati have been appointed as follows: Harry Louis Wieman, biology; Charles N. Moore, mathematics; Taylor S. Carter, physics; Joseph Eugene Root, civil engineering; Howard A. Dorsey, mechanical engineering, and Murrell Edwards, physical education.

MR. A. R. BROWN, who recently returned from an anthropological expedition to the Andaman Islands, has been elected to a fellowship at Trinity College, Cambridge.

DISCUSSION AND CORRESPONDENCE

THE TEACHING OF MATHEMATICS TO ENGINEERS

TO THE EDITOR OF SCIENCE: Doubtless many physics teachers in our technical schools and universities have followed with great interest the spirited discussion on the teaching of mathematics to students of engineering, recently published in SCIENCE, and I have been wondering if any of them had the same uncomfortable feeling which I had while listening to some of the criticisms. Again and again I could not help but think of a well-known biblical quotation about the mote and the beam. Professor Franklin's letter, October 2, shows that I do not stand alone in this matter.

Aside from actual deficiencies in the knowledge of mathematics depending upon local conditions and personal aptitude, it is apparent that our students beginning engineering subjects show often a deplorable lack of ability to express practical problems in mathematical form and to properly interpret the results after the formal operations upon the mathematical equations have been completed. As Professor Slichter says: "They very generally lack the power to do anything with the mathematics they have been taught." The statement that mathematics is nothing but a tool for the future engineer means that it is only the teaching of the mere mechanical operations enabling the student to solve certain equations. Whoever uses the phrase in this sense confounds the tools *of* mathematics which he borrows from it, with the science itself, and it would be better for him to study a little more real mathematics.

I believe, however, that we all agree that it is highly desirable that our students in engineering should obtain a greater skill in handling these tools, falsely called mathematics. But who is responsible for their lack of skill? Considering the small amount of time allotted to mathematics in many of our schools, the blame can not well be placed upon the teachers of this science alone; it is a severe impeachment of the teachers of engineering and—of the teachers of physics.

It seems remarkable that only in a few instances during the whole discussion was any mention made of physics. Do the students pass directly from mathematics to the purely engineering courses? If so, it is a grave mistake. Students taking elementary mathematics have very little knowledge of physical facts and it was well said: "To illustrate a new mathematical principle by an application to a science with which a student

is not familiar is to befog and not to illumine the subject."

The transition from mathematics which "develops the quantitative reasoning power and ability to think mathematically" to the application of this power to concrete problems is one of the hardest steps to take and—in spite of the Perry movement—it is the province of physics to help the student to make this step. Realizing this difficulty we have introduced in the course of physics for engineering students of the University of Iowa "problem hours," *i. e.*, the class is divided into small sections spending under the supervision of an instructor one afternoon a week in the solution of concrete problems. The results are highly satisfactory. Of course there are always some "abstract" thinkers who are unable to grasp the meaning of the problems, and the sooner they are made to see that they were not meant for engineers the better.

The only objection to the introduction of the problem hours is that too little time will be left for experimentation and recitations. The engineering courses are so overcrowded with "practical" subjects that the fundamentals, mathematics and physics, are more and more crowded into the background. Make the foundation broad enough to build upon it the increased number of technical courses. Give us more time and, if necessary, lengthen the engineering course. The University of Minnesota has already done so and its good example should be followed in other institutions.

The time given to physics should be one and one half years. Where the entrance requirements are sufficiently high the study of mechanics in physics may well be taken up in the second half of the first year, after the course in trigonometry has been completed and before the students have forgotten what they have learned in it. The whole semester should be devoted to this subject, while the whole of the second year is given to the remaining part of physics, taking advantage, during the latter part of the course, of the training in calculus.

Thus in closely correlating the two necessary elements, (1) the teaching of methods and principles of mathematical thinking, in the courses in mathematics and (2) the application of these methods to concrete problems, in physics, the student will be properly prepared to take the last step, namely, to obtain technical results, in his engineering courses.

K. E. Guthe

Iowa City, Iowa

CONCERNING THE REAL UNICORN

In a certain issue of Science (February 2, 1906, Vol. XXIII., p. 195) Mr. C. R. Eastman contributed an exceedingly interesting article under "Notes on the History of Natural Science," on "The Real Unicorn." In setting forth the facts as to the origin of this fabulous animal, brought to the notice of the western world by Ctesias, Mr. Eastman concludes that the source of this strange creature of the medieval mind is to be traced to certain relief profiles described by Ctesias as graven on the walls of the Persian court at Persepolis and figuring some "Asiatic ruminant new to the Greeks, with the two horns appearing in side-view as one." To the animal so depicted Ctesias gave the name of "unicorn" or "monoceros."

Unquestionably Mr. Eastman's view as to the unicorn's zoological position is probably close to the real facts. It remains to determine, if possible, what species of "Asiatic ruminant" can stand sponsor for the fabulous creature. Some horned beast known to the ancient Persians, the horns of which would appear as a single horn in profile and would point forward when the animal's muzzle was held downward as in the defensive attitude or when grazing, could be the only one so pictured as to give rise to the idea of a "unicorn" or "monoceros." Such a beast, I think, may be seen in the male Nilghai (*Boselaphus tragocamelus*), an Indian antelope, ranging at present from the southern foothills of the Himalaya to beyond Mysore, though most abundant in the central parts of Hindustan. Any one standing alongside

of a Nilghai can see at once how the spike-like horns spring straight upward, bending slightly forward, and how the near horn hides its fellow.

The knowledge of this animal would undoubtedly have reached the ancient Persian civilization from the trans-Indus region, and the artists of the period would very naturally have graven but a single horn in bas-relief profile. Further evidence that this animal was known to the ancient Persians is to be found in the name itself—"Nilghai," or "Nylghau," being of Persian origin and meaning "blue bull." The species first became known to the modern world of Western Europe about 1745, and was described and figured in *Philosophical Transactions* for that year by Dr. Parsons, in a paper entitled "An Account of a Quadruped brought from Bengal, and now to be seen in London." In *Philosophical Transactions* for 1770 Dr. William Hunter published a very full account of this animal from living specimens brought to England, and bestowed upon it the native name "Nylghau."

As the unicorn of Ctesias failed to materialize in the fauna of any country, it was relegated to the land of fabulous creatures, and became conventionalized in the art of the ancient and medieval world. If, as Mr. Eastman points out, its origin is to be found in the bas-reliefs on the walls of Persepolis, then, undoubtedly, it must have been a figure from some living prototype, and this prototype could, it seems to me, be none other than the Nilghai, the only Asiatic ruminant with horns so placed as to give rise to such a conception.

SPENCER TROTTER

SWARTHMORE COLLEGE

SCIENTIFIC BOOKS

A Manual of the North American Gymnosperms, exclusive of the Cycadales, but together with certain exotic species. By DAVID PEARCE PENHALLOW, D.Sc., MacDonald Professor of Botany, McGill University, 8vo, pp. viii + 374, with 48 text illustrations and 55 plates. Boston, Ginn & Company, The Athenæum Press. 1907.

The book is prepared for "working botanists," "engineers, and especially foresters." For the latter the author hopes that his histological diagnoses may be of great value in the difficult task of identifying the various species of coniferous woods in the absence of the usual botanical data. The author tells us that

> The present work had its origin in 1880 in an attempt to construct a system of classification for the North American Coniferae based upon the anatomy of the vascular cylinder of the mature stem. The fundamental idea was that such a classification would prove of great value in the identification of material used for structural purposes, but investigations had not been carried very far when it became manifest that some such arrangement was imperatively demanded in other directions and for purposes of a more strictly scientific character.

The author here refers to the value of such data in the study of fossil plants.

The book is divided into two parts, the first, devoted to the general anatomy of the conifers, covering half of the volume. In this the reader or student finds very useful general directions for the preparation of material, discussions of growth-rings, tracheids, bordered pits, medullary rays, wood parenchyma, resin passages, etc. In part second the author arranges and describes the genera and species of North American Gymnosperms (exclusive of Cycadales) under three orders, viz., Cordaitales (including the extinct *Cordaites,* and the surviving *Dammara,* and *Araucaria*), Gingkoales (including the surviving *Gingko*) and Coniferales (including seventeen genera of surviving or recent gymnosperms). Here we have the species of each genus separated by means of a convenient key. Then we have the species arranged systematically, and in each case the scientific name is first given, with a citation of the authority. Next follows a paragraph descriptive of the transverse section, a second for the radial section, a third for the tangential section. For extinct species the mode of fossilization and the geological position are given, while for living species data are given as to specific gravity, fuel value, strength, etc., and geographical distribution.

An appendix in which the anatomical characters are brought together for easy comparison, a list of the literature cited, and a good index close the text, following which are the plates, all excellent half-tone reproductions of photomicrographs of wood sections.

In the chapter on general phylogeny the author gives us his ideas as to the phylogeny of the Coniferales in a suggestive diagram (page 161). Proceeding from the main stem of the Cycadofilices are two considerable branches the Cycadales (including *Bennettitaceae* and *Cycadaceae*), while the other through *Poroxylon* soon subdivides into Cordaitales (*Cordaites, Dammara, Walchia* and *Araucaria*), Gingkoales and Coniferales. In the latter *Taxaceae* and *Podocaepaceae* constitute a primitive side line: later we find *Taxodineae,* then as another side line *Cupressineae,* while the main line terminates in the close group, *Abies, Tsuga, Pseudotsuga, Picea, Larix, Pityoxylon, Pinus.* The last-named genus is regarded as the highest differentiation of the Coniferales.

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Royal Society of London Catalogue of Scientific Papers, 1800–1900. Subject Index, volume I., Pure Mathematics, Cambridge; at the University Press. 1908. Pp. lviii + 666.

This is the first volume of a subject index, which is to be published as "separate index-volumes for each of the seventeen sciences of the schedule of the International Catalogue, viz., mathematics, mechanics, physics, chemistry, astronomy, meteorology, mineralogy, geology, geography, paleontology, biology, botany, zoology, anatomy, anthropology, physiology and bacteriology." This index will complement the great Catalogue of Authors which is being issued by the same society and of which twelve large volumes (1800–1883) have been published, while the volumes covering the period from 1884 to 1900, inclusive, are in preparation. These two catalogues will have close contact with the "International Catalogue of Scientific Literature" which contains an author and a subject catalogue of the scientific publications beginning with 1901. The present work is arranged in accordance with the schedules of the different sciences which form the basis of the International Catalogue.

The preparation of a complete subject index of the scientific papers published during the nineteenth century is an enormous undertaking which can, however, be well justified by the usefulness of such a work when completed. The volume before us is said to contain 38,748 entries referring to 700 serials. While these numbers may appear large, yet they are too small for a complete index of the mathematical papers appearing during the nineteenth century, and it is not difficult to point out omissions. In fact, a number of fairly well-known mathematical periodicals were overlooked altogether, and a complete list of mathematical papers would have demanded reference to about 1,100 periodicals instead of to 700. As instances of omitted periodicals we may mention, *Zeitschrift für mathematischen und naturwissenschaftlichen Unterricht* and the *American Mathematical Monthly.*

Although the volume under review exhibits clear evidences of incompleteness, it contains such a large amount of information in a convenient form that it is difficult to see how a live mathematician can afford to get along without it, especially since there is no other work in existence which can take its place. By limiting itself to periodic literature, it complements Wölffing's "Mathematischer Bücherschatz" (1903), which aims to give a complete list of the most important mathematical text-books and monographs published during the nineteenth century. Unfortunately, Wölffing's work, arranged under 313 headings, is still less complete than the one under review, and presents numerous other evidences of hasty preparation.

A very commendable feature of this great bibliographical undertaking of the Royal Society is that it tends to make it easier to keep in touch with the advances that are being made in several great subjects of scientific inquiry. If the volumes devoted to the various subjects are parts of the same set and are arranged according to the same gen-

eral plan, the scholar is much more apt to acquaint himself with advances outside of his particular field, and thus such an arrangement tends, at least in a slight degree, towards maintaining that community of interest and sympathy which is so helpful in the harmonious development of science. As Darboux pointed out in his recent address before the International Congress of Mathematicians at Rome, there is danger of estrangement even in a single science, and this danger is still more real as regards the various sciences which should be mutually helpful.

In arranging the material of the present volume we are told that it frequently became necessary for a specialist to examine the articles in some detail, as the headings were often too vague to give a definite idea in regard to the results which were reached in the articles. This is especially true of those which appeared between 1884 and 1900, while most of the earlier papers were classified according to their headings. Although great care seems to have been exercised, it is not difficult to find instances where the classifier did not exhibit sufficient knowledge of the subject. For example, it is difficult to see why a note on "Test of a simple group" should be classed under general group theory while such a general article as that of Dyck on "Groups of discrete operations" is classed among the more special articles on discrete groups of finite order. An instance where the classification according to the headings of articles is entirely misleading is furnished by the papers by Cockle which appeared in volumes VI., VII. and VIII. of the *Cambridge and Dublin Mathematical Journal,* under the title of "Method of vanishing groups," although they relate to a species of indeterminate analysis and have nothing in common with what is now regarded as group theory. In the present volume they appear, however, under this general heading.

An instance where the classifier seems to have misunderstood the meaning of a technical mathematical term is furnished by the note on *permutants,* published by Bilenki in *Nouvelles Annales de Mathématiques* (1900). As the heading implies, this note relates to the theory of matrices, but it is classified with substitutions and permutations in the present volume. It may be of interest to observe that the term permutants does not appear in Müller's "Mathematisches Vocabularium," although this valuable work contains more than ten thousand technical terms with their French equivalents.

These instances suffice to make it clear that the scholar can not regard the present index as final authority, either as regards completeness or as regards reliability. On the other hand, extensive historical research among the literature of the historical century will still be richly rewarded. The present volume will, however, be of great assistance in making such research on the part of the mathematician more effective, and it is to be hoped that later editions will be free from many imperfections which could scarcely have been avoided in the first edition of such a very extensive work. The undertaking is a highly laudable one and bespeaks in clear terms a willingness to render an important service, which offers little reward beyond the pleasure in rendering such a service. From this viewpoint the bibliographical activity of the present time exhibits a most inspiring picture of the trend of thought actuating scientific men.

G. A. MILLER

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NOTES ON ENTOMOLOGY

THE Germans have always been considered the authorities on forest entomology, and their text-books the standards. Now a most excellent work has been issued in English by A. T. Gillanders.[1] Mr. Gillanders is manager of the forests of the Duke of Northumberland, and so has had much practical experience. The insects are considered under the order to which they belong; there being tables to families, and often to the genera. After each group there is a short bibliography. Many of the illustrations are photographs of injured parts of the tree, and of the insect upon it. The last chapter contains a list of trees with their injurious insects. Perhaps the weakest

[1] "Forest Entomology," pp. 422, figures 351. W. Blackwood and Sons, London, 1908.

part of the volume is the insufficient treatment of larval forms; and the author could have found much information on the life history of many species by consulting the pages of the various English entomological journals.

Recent numbers of the "Genera Insectorum" include the Brenthidæ (fasc. 65, pp. 88, 2 pls., 1908), a family of curious elongate beetles allied to the true weevils. The author is H. von Schönfeldt. He catalogues 111 genera and 624 species, almost all of which are tropical. This part appears to be well prepared. Professor V. L. Kellogg treats of the Mallophaga (fasc. 66, pp. 87, pls. 3, 1908). Although it treats of the species of the world, it is very much less useful than several of the author's previous publications dealing with American forms of this order. Dr. G. Enderlein has reviewed the neuropterous family Coniopterygidæ (fasc. 67, pp. 18, pls. 2, 1908). As before, the author has published, a few years ago, a very much more valuable monograph of the group. Dr. F. Hendel presents the sub-family Lauxaninæ of the dipterous family Muscidæ (fasc. 68, pp. 66, pls. 3, 1908). There is a general account of the biology, and the generic characters seem to be thoroughly elucidated. Albert Bovie is the author of three fascicles on parts of the great family Curculionidæ, or weevils. Fasc. 69—Entiminæ, pp. 7, 1 pl.; fasc. 70, Cryptodermidæ, pp. 3, 1 pl.; fasc. 71, pp. 11, 1 pl.—Alcidinæ. All of the forms are tropical. A useful feature is the figuring of a number of types.

An article of great interest to all entomologists is that by Mr. W. F. Kirby on the length of life of British entomologists.[2] Mr. Kirby has looked up the figures for 309 persons and finds that entomologists live much longer than many other classes. He suggests that the list should induce insurance companies to offer reduced rates to entomologists. The greatest number of deaths (15) occurred at the age of 72; the next (12) at 65; the next (10) at 74; 9 at 58, at 60, at 62, at 66, at 67 and at 70; 8 at 76 and at 82; 9 lived over 90 years. It is hardly possible that figures for American entomologists would produce as favorable results.

Dr. E. Bergroth is the author of a very useful catalogue of the species of the Hemipterous family, Pentatomidæ,[3] that have been described since the catalogue of Lethierry and Severin, which was issued in 1893. These fifteen years have witnessed great activity in this family; no less than 1,000 species have been added, and 140 new genera proposed during this time. Africa has furnished a larger proportion of the new forms than any other continent; South America and Australia are well represented, but the Central American region is scarcely mentioned.

Dr. O. M. Reuter has given a notice of changes in names and synonymy preliminary to a monograph of the Nabidæ.[4] A number of species considered are from the United States. The *Reduviolus limbatus* of Europe he records from Canada and Colorado, and our little *Carthasis,* previously considered as the Mexican species, he describes as *C. contrarius.* He also describes a new species from California. It is with great regret that we learn that Dr. Reuter can not do further original work on insects.

Australian mosquitoes are treated by Thos. L. Bancroft in a recent number of the Annals of the Queensland Museum (No. 8, 64 pages, 1908). He has taken 32 species in Queensland, gives full descriptions of them, and often notes on the habits of the adults. Only four species are common enough to be a nuisance, and two of these were introduced, *Culex fatigans* and *Stegomyia fasciata.*

Mr. R. Demoll has made an extensive attempt to homologize the various parts of the cibarian structure of bees.[5] He gives a comparative account of the morphology of the

[2] "On the Longevity of British Entomologists," *Zoologist* (4), XII., 216–221, 1908.

[3] "Enumeratio Pentatomidarum post Catalogum Bruxellensem descriptarum," *Mém. Soc. Entom. Belg.,* XV., pp. 130–200, 1908.

[4] "Bemerkungen über Nabiden, nebst Beschreibungen neuer Arten," *Mém. Soc. Entom. Belg.,* XV., pp. 87–130, 1908.

[5] "Die Mundteile der solitären Apiden," *Zeitschr. wissensch. Zool.,* XCI., 1–51, 1908.

mouth parts in all of the principal genera of bees. There are chapters on the function of the tongue, and on the adaptation of the mouth parts to the flowers visited by the bees. There are many text-figures, and two fine double plates.

THE British Museum (Nat. Hist.) has issued an illustrated guide to the insects exhibited in its halls; evidently prepared by Mr. Waterhouse.[6] There is a general account of insects, and full treatment of the lower orders. The Coleoptera and Hemiptera are barely mentioned, as the series is not completed in these groups; and of the Diptera only the blood-sucking forms receive attention. A number of the illustrations are photographs of nests of wasps, ants and termites.

MR. M. T. SWENK has given a revision of our species of a part of the large genus of bees —*Colletes*.[7] He treats of the species which have black hair on the thorax of the female; these are 26 in number. Besides the technical descriptions, which appear very complete, there is much matter on the distribution, flower-habits, etc., of the various species. The three plates illustrate the seventh ventral segment of the male. It is unfortunate that the reprint bears no indication of the journal of which it forms a part.

NATHAN BANKS

SPECIAL ARTICLES

ON A COMMUNICATION BETWEEN THE AIR-BLADDER AND THE EAR IN CERTAIN SPINY-RAYED FISHES

A CONNECTION between the air-bladder and the ear in spiny-rayed fishes has been touched upon from time to time since Weber described the elaborate connection between these organs in the Osteriophysi (cat-fishes, minnows, etc.) brought about by the chain of ossicles which bears his name. In the spiny-rayed fishes, however, this connection has usually been through the apposition of the air-bladder to a cartilaginous wall where certain of the lateral cranial bones have failed to come together to complete the bony wall of the lower part of the pterotic capsule. The perilymph which bathes the inner surface of the cartilaginous wall and the auditory organs completes the communication. Such is the case in *Lotella*[1] and in *Myripristis*.

Recently I have found in *Nematistius pectoralis* a more highly specialized connection between the ear and the air-bladder than has been noticed before among the spiny-rayed fishes; the connection in this case being brought about through a long tunnel actually penetrating the basioccipital bone and being confined to that bone at its lower end.

In *Myripristis* (*M. occidentalis*) the lower part of the pterotic capsule is separated off as a special sacculus or otolith chamber in the outer wall of which is a large cartilaginous area between the prootic in front, the basioccipital below and the exoccipital above and behind. To this cartilage a large prolongation from the air-bladder is broadly attached.

In *Holocentrus* (*H. ascensionis*) this condition is somewhat modified. On the side of the cranium the otolith chamber forms an elongate and tube-like prominence, which is extended backwards to the side of the occipital condyle, where it opens widely through a symmetrical, round, smooth aperture. The side of the otolith chamber is mostly formed by the prootic prolonged backwards, though the exoccipital above and the basioccipital below assist materially.[2] The length of the chamber is nearly filled by a very large otolith. This posterior opening, though obviously of a more highly specialized character than in *Myripristis*, still occurs between the same bones. It apparently has no cartilaginous covering homologous with the cartilaginous lateral area in *Myripristis*, but the thin inner membrane of the air-bladder forms a sort of a loose

[6] "A Guide to the Exhibited Series of Insects," with 62 illustrations, 57 pages, London, 1908.

[7] "Specific Characters in the Bee Genus, *Colletes*," pp. 43–102, 3 pls., 1908; University of Nebraska, Contrib. Dept. Entom., No. 1.

[1] Reported on by T. J. Parker, *Trans. N. Zeal. Inst.*, 1882, Vol. 15, p. 234.

[2] For a picture of the cranium of *Holocentrus ascensionis* showing the exterior of the otolith chamber see "The Osteology of Some Berycoid Fishes," Starks, *Proc. U. S. Nat. Mus.*, Vol. XXVII., p. 611.

tympanum over it, while the thicker, more fibrous, outer membrane is attached to the bone around the mouth of the opening. The air-bladder is further anchored anteriorly by a stout Y-shaped ligament firmly attached to the basioccipital. The otolith chamber opens above into the brain chamber at about the middle of its length by a rather small (as compared with other fishes) foramen through which the sacculus communicates with the utriculus and the other auditory elements.

Peculiarly *Holocentrus suborbitalis* Gill, a hitherto supposedly closely related species, has no posterior opening from the otolith chamber, the chamber does not form a tube-like prominence at the side of the cranium, the otolith is comparatively small, and the air-bladder does not extend forward to the cranium. These characters seem of sufficient importance to make *suborbitalis* the type of a distinct genus, for which the name *Adioryx* is proposed.

In a prepared dry cranium of *Nematistius* there appears no long tube-like otolith chamber at the side of the cranium, but at each side and just below the occipital condyle there is a sudden bulging of the basioccipital bone containing the wide-open mouth of a long tunnel leading upward to the brain chamber, and opening into the latter in the same way and at the same place that the otolith chamber of *H. ascensionis* opens into it. In a dissection prepared from an alcoholic specimen a small otolith is found in the upper end of the tunnel. Into the lower part of the tunnel the air-bladder projects, lining it with a delicate membrane; and near the middle of the tunnel, at its narrowest part, the air-bladder closes it, thus forming a delicate membranous pocket.

The auditory connection in the case of *Nematistius*, where a special tunnel is opened through the bone to accommodate it, is obviously of a deeper-seated nature than in any of the other examples where advantage is taken of interossified areas even though these areas have become somewhat specialized. The small taxonomic value of the connection of the air-bladder to the ear is illustrated in *Adioryx* and *Holocentrus*, where in one case the connection is absent while in the other it is present and with the cranial bones modified to accommodate it. It can probably be used only in showing relationship between species or genera at the most. The condition as it exists in *Nematistius* may prove of greater value in this respect.

Edwin Chapin Starks

A NEW SOIL SAMPLER

A laboratory study of the physical characteristics of soils has come to be considered of primary importance in soil investigations. Much has been done within recent years toward studying soils from this standpoint with air-dried samples. Comparatively few attempts, however, have been made to study samples which possessed the texture, structure, moisture content and other features found under field conditions. For many reasons, investigators can not materially add to our knowledge as long as data are secured only from air-dried samples. Real progress in research can begin only with the use of apparatus designed to take samples of adequate volume and of such character as will enable the investigator to deal in the laboratory with samples which possess essentially the same physical properties as are possessed by the soils in the field.

Many devices and methods have been introduced for soil sampling.[1] For general physical and chemical analytical work the standard methods of sampling are all essentially the same and each of them has proven more or less satisfactory for the purpose for which it was devised.

However, with one or two exceptions none of the methods of sampling which have thus far been introduced makes it possible to bring to the laboratory a sample of soil in the condition in which it rested in the field.

In the method of sampling proposed by the investigators at Rothamsted, a steel or brass frame, fitted with a keen cutting edge and open at top and bottom is driven into the soil by repeated blows with a wooden or iron

[1] See Wiley's "Principles and Practise of Agricultural Analysis," Vol. I., pp. 61–85, for a discussion of methods for sampling soils. See, also, Hall's "The Soil," pp. 45–48.

hammer to any desired depth or until its upper edge is level with the surface of the soil. This method has objections. For example, the core of soil within the frame is generally more or less compacted during the process of sampling. For this reason, the sample of soil does not possess unchanged physical characteristics, and hence it can not be used to advantage in a study of many of the more important physical properties of the soil.

A method of sampling which more closely meets the requirements of the soil physicist, who desires to determine the permeability of soil to water or air and to study other physical properties, has been proposed by Whitney, and is described by Wiley in the following words:

> An excavation two feet square and eighteen inches deep is made in the soil. On one side of this hole the sample of soil or subsoil is secured by means of a narrow saw blade and a sharp carving knife. The sample of soil should be two inches square and from three and a half to four inches long. It is placed in a brass cylinder three inches long and three and a quarter inches in diameter. The open space in the cylinder is filled with paraffin heated just to its melting point.

This method, also, is open to objections. In the first place, it is often difficult to secure an unbroken core of soil to a considerable depth, and, further, the sample which is taken by this method is too small for many lines of study.

The writer with the assistance of M. W. Pullen, of the Engineering Division, Iowa State College, has devised a sampler by which he has largely overcome each of the objections referred to in the preceding paragraphs, and is enabled to take, in a comparatively short time, a core of soil, three inches in diameter and of any desired depth up to about fifteen inches, which possesses every physical characteristic of the soil in the field. This apparatus makes it possible for the operator to quickly and easily secure a large sample of soil for mechanical and chemical analyses. For this purpose it promises to prove more useful than some of the devices which are now employed. However, the new sampler is especially adapted for taking samples of soil for the determination of volume weight, moisture content, water-holding capacity, permeability to water or air, capillary movement of water and other physical characteristics. The sampler has been tested in many different types of soil. No particular difficulty has been encountered except in coarse gravel and in heavy soils which were very wet. When the soil is in a condition favorable for crop growth, a sample of soil three inches in diameter and ten or twelve inches in length may easily be secured by two operators within six or eight minutes. A single operator finds it somewhat difficult to get a sample. However, an experienced man, by using a spade two or three times to remove the soil from the sides of the machine, has secured samples without undue exertion.

The total weight of the sampler, exclusive of the wooden frame, is twenty-six pounds and it may be transported from one point to another with little difficulty.

During the past year a large number of laboratory determinations have been made with samples of soils which were taken with the new sampler. The data secured are for the most part very satisfactory and are of such a nature as to justify the conclusion that the sampler will prove of value whenever a study is made of the physical properties of soils.

The new soil sampler is not complicated and may be made by any first-class mechanic in a well-equipped machine shop. The sampler consists of an outer cylinder of steel, fitted at the lower end with two sets of cutting teeth of tool steel; spiral grooves are milled on the outer side of this cylinder which serve to give increased cleaning capacity to the sampler.

A steel cylinder, with an inside diameter of a little more than three inches and with a guide rod nineteen inches in length, fits snugly within the outer cylinder. This inner cylinder does not turn with the cylinder which carries the cutting teeth, but is held rigidly in place by a key. If this cylinder were to turn, the core of soil would be broken and would thus be rendered useless for a determination of certain physical properties of the soil. A cylinder made of heavy galvanized

sand screen with eight meshes to the inch is placed inside of the inner steel cylinder. The screen or wire cylinder should fit into position perfectly and there should be no open space between this cylinder and the inner steel cylinder. As the outer cylinder bores into the soil and separates a core of soil from the soil mass, the inner steel cylinder, carrying the wire cylinder is carried downward at a rate uniform with that of the outer cylinder and the core of soil is pushed with but little friction and in an unbroken condition into the wire cylinder. When a sample of soil has been secured to the desired depth, the sampler is withdrawn and the wire cylinder which contains the core of soil is removed from the machine. When the soil sampler is in operation, it is held rigidly in position by a wooden frame which is supported on four legs.

In conclusion it may be said that the advantages which the writer thinks should commend this new apparatus for taking soil samples and particularly those which are used for the determination of the physical characteristics of the soil, are the rapidity with which samples can be secured, and the unchanged physical condition of the core of soil.

The claim is not made for this method that the samples duplicate closely when tests are made regarding the physical properties of a soil type. However, it is the opinion of the writer that the variations are due wholly to factors other than those connected with the operation of securing the samples of soil, and it is not probable that these factors can be eliminated.

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Note on the Crystal Form of Benitoite

Of the thirty-two possible crystal classes deduced mathematically from the empirical law of rational indices by Hessel in 1832, three have no known representative up to the present time. They are the tetragonal bisphenoidal, trigonal bipyramidal and ditrigonal bipyramidal classes. The writer believes that the last-mentioned class, the ditrigonal bipyramidal, has a representative in the new gem mineral, benitoite ($BaTiSi_3O_9$) recently described by Louderback.[1]

Several crystals of this interesting mineral obtained through R. M. Wilke were examined and measured, with the following results. The dominant form is a trigonal bipyramid, which determines the habit. If this is taken as the positive unit form, $10\bar{1}1$, the other forms (taking the axes of reference diagonal to the planes of symmetry as in tourmaline) are: $01\bar{1}1$ and $01\bar{1}2$ trigonal bipyramids; 1010 and $01\bar{1}0$, trigonal prisms; and 0001, pinacoid. Of these $01\bar{1}1$ is small, $01\bar{1}2$, a narrow form truncating the polar edges of $10\bar{1}1$ and only found on one or two crystals. Of the two prisms $10\bar{1}0$ is invariably the more prominent, but $01\bar{1}0$ measures a little more in the direction of the $\dot{c}$-axis. The pinacoid 0001 is a small triangular face and on one crystal there were triangular markings parallel to its edges.

Although the general form, $hk\bar{i}l$, ditrigonal bipyramid, is absent, it is pretty certain that the crystals belong to the class mentioned as there is a horizontal plane of symmetry in addition to three vertical planes of symmetry and three axes of two-fold symmetry as well as a single axis of three-fold symmetry.

Another possibility is that the crystals may belong to the trigonal bipyramidal class in which case the dominant form would be an $hk\bar{i}l$ face, but limit forms are much more common among crystals than general forms. It may also be urged that the crystals may be supplementary twins of the ditrigonal scalenohedral or of the ditrigonal pyramidal class, but as the prism faces show no grooves, nicks, striations or seam through the center, it seems reasonable to regard them as simple crystals.

Sufficient angles were measured to establish the forms as given above. The average of ten values for the angle $(0001 \wedge 10\bar{1}1)$ varying from 40° 0′ to 40° 22′, gave 40° 10′ as compared with Louderback's value of 40° 14′.

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Stanford University, Cal.,
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[1] *Bull. Dept. Geol. Univ. Cal.*, Vol. 5, pp. 149–153, 1907.